

**Lazaroa**

ISSN: 0210-9778

<http://dx.doi.org/10.5209/LAZAROA.51054>

 EDICIONES  
COMPLUTENSE

## Forest typology of broadleaf forests from Sierra Maestra, Eastern Cuba

Orlando J. Reyes<sup>1</sup>

Received: 28 January 2015 / Accepted: 23 March 2016

**Abstract.** A phytosociological study of the forests from Sierra Maestra is conducted, following the methodology of the Zurich- Montpellier School. They are transformed into a forest typology using the standards of the Institute of Agro-Forestry Research. In general, 35 types and/or subtypes are presented. From this group, the most abundant ones belong to semi-deciduous microphyll forest, followed by those from mangroves and mountain rainforest, respectively. Silvicultural treatments are needed; among them, the protection forests are those found above 800 m asl and mangroves.

**Keywords:** Forests; forest typology; Sierra Maestra; Eastern Cuba.

### [es] Tipología forestal de los bosques latifolios de la Sierra Maestra, Cuba Oriental

**Resumen.** Utilizando la metodología de la Escuela Zürich-Montpellier se realiza un estudio fitocenológico de los bosques de la Sierra Maestra, el cual es transformado en una Tipología Forestal usando los normas del Instituto de Investigaciones Agro-Forestales. En general, se presentan 35 tipos y/o subtipos, de los cuales los más abundantes pertenecen a los bosques semidecíduos micrófilos, siguiéndole los manglares y la pluvicultura montana. Se precisan los tratamientos silvícolas, entre los cuales constituyen bosques de protección los que se encuentran por encima de los 800 m snm y los manglares.

**Palabras clave:** Bosques; Tipología forestal; Sierra Maestra; Cuba Oriental.

### Introduction

Forests provide many goods and services to humanity, mainly related to the conservation of biodiversity, soil and water. In the current situation of climate change they also work as carbon sinks, so it is essential their conservation and sustainable use. The number of Cuban forest formations depends on the classification used: Bisse (1988) identified 16 forest formations located throughout the country; while Reyes (2011-2012) found 23, for Eastern Cuba (with six subtypes) and 11, for Sierra Maestra, with four subtypes (Reyes, 2006). The forestry law in Cuba categorized Cuban forests as producers, for conservation and protective. The 46.1% of the Cuban forest heritage are protective areas, while the 32.3% are for timber production (Alvarez & al.,

2012). This shows the significance the Cuban state gives to forests.

The Cuban forest area has increased significantly: from a 13.4% of degraded forests in 1959 (Russó Milhet, 2015), to a 26.2% in 2009 (Alvarez & al., 2012) and 28.6% in 2014 (CITMA, 2014; Parada & Torranzo, 2014) in relation to the surface of the Cuban archipelago.

While studying nature, it is important to recognize the set of ecological conditions (oecotope) that are expressed in the characteristics of the vegetation and its floristic composition. Forest typology is of great significance when the results of such interrelationship constitute in a particular type of forest. Therefore, it is considered as forest typology the study of forest communities in its relation to environmental conditions; since they establish the quality and productive potential of the forest stations (sites). Alvarez & Varona

<sup>1</sup> Eastern Center of Ecosystems and Biodiversity (BIOECO), Ministry of Science, Technology and Environment (CITMA), José A. Saco Nr. 601, esq. Barnada, Santiago de Cuba, Cuba. E mail joel@bioeco.cu

(1988) considered as a forest site to all edaphic, climatic and biotic factors that determine the persistence and intensity of biomass production (gross primary productivity) of certain forest community, be it natural or created by man.

There are two basic methods for studying forest sites depending on the environmental situation: with emphasis on the oecotope (Kopp, 1965; Thomasius, 1965; Schwanecke, 1970) or prioritizing vegetation (Del Risco, 2000a, b; Del Risco & Samek, 1984). The method that prioritizes the oecotope is recommended in areas where the vegetation has been destroyed, while the other is applied in stations where the existing vegetation expresses the potential of that oecotope. In this work, the second method is applied because it is conducted in developed vegetation, which, although it is often secondary, also expresses the environmental conditions, including

ecosystem values, which contribute to forest typing and planning.

## Materials and Methods

### Natural conditions of the study area

Sierra Maestra (Figure 1) is a very complex area, geologically speaking. There, the Palaeocene-Eocene volcano-sedimentary rocks of the Cobre Group predominate, mainly andesites and tuffs (Mendez *et al.*, 1994). Relatively large granites intrusives occur in isolated areas of the southern slope (around Potrerillo river, Pinar de las Canas, La Francia, Nima Nima, Juraguá-El Olimpo, etc). Likewise, the formations Maya River and Jaimanitas prevail in the coastal areas (Com. Cubano Húngara, 1976).

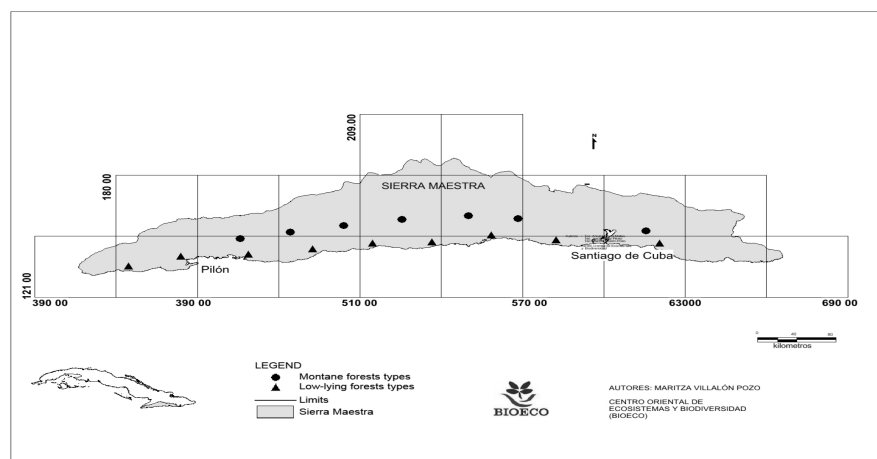


Figure 1. Main forests types in Sierra Maestra range (Cuba)

From 1500 m asl, the leached yellowish ferrallitic soil predominates. According to Renda (1989), the pH in the upper horizons is from acid to very acidic; it reaches values of 4.45 to 5.3 in water and 3.5 to 4.15 in CIK. The sum of basic cations (Change Bases Capacity, CCB, S value) is very low, generally ranging between 1.44 and 5.02 cmol (+).kg<sup>-1</sup>. The cation exchange capacity (CIC, T value) varies from 2.5 to 18.75 cmol (+).kg<sup>-1</sup>. There are very low content of calcium, magnesium and potassium. Beneath this soil, to about 600 m a.s.l, the soils are mainly leached red ferrallitic, from deep to very deep, and often derived from ferrallitic weathering crust in more or less stable places. They are from

acids to highly acidic (pH H<sub>2</sub>O 4.0-5.5) and the S value is smaller than 7 cmol (+).kg<sup>-1</sup> (Renda, 1989; Renda & *al.*, 1981b).

Siallitic brown and fersiallitic reddish-brown soils dominate the low and pre-mountain areas. The siallitic brown soils (without carbonate) have a variable depth: they usually have an S value ranging from 13 to 18 cmol (+).kg<sup>-1</sup> on the south side, and from 24 to 50 cmol (+).kg<sup>-1</sup> (rarely) in the north, where generally have higher saturation. The siallitic brown soils (with carbonate) are abundant in the north side, and they are richer and more saturated than the above. CCB is usually between 47 and 78 cmol (+).kg<sup>-1</sup> and the CIC ranges from 49 to 80 cmol (+).kg<sup>-1</sup> (Renda & *al.*,

1980, 1981a, 1981b, 1982). The ferrallitic reddish-brown soils often eroded and usually with rocky outcrops and stones in the profile, have an approximated S value of 13 cmol (+).kg<sup>-1</sup> on the southern slope (Renda & *al.*, 1980-81). In the north, they are somewhat richer, wherein the CCB ranges from 21 to 43 cmol (+).kg<sup>-1</sup>. They are mainly observed in rocks from the Cobre Group.

Over the granitoids, there are usually grayish brown soils, sometimes sandy and poor. Their pH goes from slightly acidic to acidic, with an S value of 4 to 5 cmol (+).kg<sup>-1</sup> in the first horizon, and even lower below it.

In coastal limestone terraces, the very shallow red soils (rendzine) occupy the fractures and crevices of the dogtooth rock. A red ferrallitic soil is observed in coastal terraces, limestone hills and cumulative plains from Sierra Maestra's westernmost. Its CCB in the first horizon is 19 cmol (+).kg<sup>-1</sup> and the T value is 24.3 cmol (+).kg<sup>-1</sup>. Both values decrease in the lower horizons (Renda & *al.*, 1981c).

In the higher areas of Sierra Maestra, it rains between 1600 and 2000 mm, with a less rainy season from November to April (Trusov & *al.*, 1983). It is noteworthy that cloud condensation is produced between 800 and 1200 m asl (horizontal precipitation, moist shade, low clouds). Hence, when it occurs, a 100% of relative humidity is reached; sometimes it runs by the stem (Boytel Yambú, 1972). On average, in Gran Piedra (weather station at 1100 m asl) there are 239 days a year affected by horizontal precipitation, of which 163 days have dense fog, from October to May occur 20 days or more per month (Montenegro, 1990).

In the higher parts of western Sierra Maestra, above 1500 m asl, the influence of such horizontal precipitations is almost daily. Air saturation, however, is almost little, even with dense fog, which is formed lower down and goes up with the wind. These conditions produce a high tension on the foliage, which may turn it into microphyll and the decomposition from withered leaves is very slow (Reyes & Fornaris, 2011).

In Carso de Baire (north side), around 500 to 700 m asl, the mean annual rainfall varies from around 1200 mm in the less elevated areas up to more than 1600 mm in the highest (Gagua & *al.*, 1989). The average rainfall in La Tabla (600 m asl) is 1634 mm, varying from 1216 to 2320 mm through the years: on average, there are 94 rainy days a year. A rainy period from March to November, with 85% of rainfall is clearly defined, as well as other less rainy from December to February with 15%. The heaviest rainfall ranges between 5.1 and 30 mm.

The coastal and pre-coastal strip, in the south of Sierra Maestra, is one of the most climatically extreme areas of Cuba. In the east of Santiago de Cuba's Bay, the weather is bixeric. The average rainfall hardly goes beyond the 700 mm a year. Exceeding the 100 mm, the rainiest months are May, September and October; while the driest months are December, March and July, in which rarely exceed 30 mm. The rainy days are usually less than 40 per year. To the west of the bay, rain increases gradually to about 1200 mm in front of Pico Turquino, where mountains plunge straight into the sea. From this point, rain then gradually decreases up to 800 mm near Cabo Cruz.

The air mean temperature in Gran Piedra (1100 m asl) is 18.4°C; the average minimum is 15.7°C and the average maximum, 22.4 °C. On top of Pico Real del Turquino, the air mean temperature reaches about 13°C (Montenegro, 1991a). On the north side, around the 500 and 700 m asl, the mean annual temperature is 20-22°C in the upper parts and 22-24°C in the lowest (Lapinel, 1989). By contrast, the mean annual temperature in the coastal zone ranges from 24-26°C, with an average maximum of 30-32°C, and an average minimum of 22-24°C (Montenegro, 1991b). The decrease in temperature per 100 m of elevation in western Sierra Maestra is 0.62°C, and 0.66°C in the northern and southern sides respectively (Montenegro, 1991b).

At the top of Sierra de la Gran Piedra, relative humidity reaches high levels throughout the year, from just over 87% to about 92% among the different months. At 13:00 h, it has a minimum between 80 and 86%, and a maximum, at 07:00 h, from 88 to 92% (Montenegro, 1990). The mean annual relative humidity in Carso de Baire is from 80 to 85% (Montenegro, 1991c) and in Contramaestre (bottom, north side), is of 52 to 60%. In the coastal area, the mean annual relative humidity varies from 75 and 80%, the mean annual at 13.00 h is from 70 to 75%, and at 07:00 h, it is from 80 to 85% (Lapinel, 1989; Montenegro, 1991c). In Santiago de Cuba (lower part, southern slope) it varies between 47 and 60%. At 13:00 h, such humidity increases with altitude from the bottom up to 1400 m asl, remaining constant to about 1600 m asl. Then it decreases to the top of Pico Real del Turquino (Montenegro, 1991c).

Evaporation in Gran Piedra is low and for eight months in the year, it does not exceed 100 mm per month (Montenegro, 1990). The months with the highest evaporation

(Piche) are april, june, july and august (from 75 to 82 mm), and with the smaller one, from october to january (less than 60 mm) (Montenegro (1991d). In turn, in the coastal zone, evaporation fluctuates between 1900 and 2000 mm (Crespo, 1989). From March to September, it is over 110 mm (Piche), March, April, July and August are the months with the greater evaporation (130-1400 mm), and November and December show the smallest evaporation records, with 85 mm (Montenegro, 1991d). In Carso de Baire, the mean annual evaporation is of 1300 to 1500 mm (Montenegro, 1991d).

## Methodology

The present paper used some data obtained from phytosociological studies (205 phytosociological plots from 625 m<sup>2</sup>) conducted in the forests of Sierra Maestra; some of them already published (Reyes & Acosta, 2003, 2004; Reyes & *al.*, 2004a, b; Reyes & Martínez, 2005) and some others still unpublished. These syntaxa are transformed into this forest typology using the standards of the Institute of Agro-Forestry Research (Del Risco, 2000a, b). The scrub syntaxa, grasslands, etc. were not taken into account in this study.

Two main types of indicators were considered:

- Forests characteristics.
- Oecotope characteristics.

## Forest Characteristics

Del Risco (2000a, b) methodology for strata, vertical structure of canopy layer, abundance-coverage, presence degree and each species's participation was applied for studying the forest characteristics. Out of it, the characteristic combination of each forest type was created. In case of analogous forests, having a similar feature combination, the differential combination was determined. In addition, the canopy layer or sub-layer coverage was considered, as well as the shrub and herbaceous layers.

**Strata (layers):** Samek (1973) criteria for separating the three main strata (canopy, shrub, herbaceous and ferns) and the other synusiaes were used according to:

Canopy: Trees greater than 5 m in height.

Shrub: Shrubs and little trees between 1 and 5 m.

Herbaceous: Plants under 1 m. Ferns were considered separately; there are different types of terrestrial ferns. In some forest, they are found in the three layers described before, mainly in the herbaceous layer.

Lianas: It involves the different types of vines or lianas.

Epiphytes: Plants living over the phorophytes without being parasites. Sometimes they play an important role as indicators in different forest types, especially of environmental humidity.

**Vertical structure of canopy layer (C/V).** Components of this layer were individually calculated, directly on the plots. Kraft classification (in Samek, 1974) was used:

Predominant (P): The trees beyond the primary level.

Dominant (D): Those making up the main level.

Codominant (C): Those in the lower part of the primary level, but which are not well developed.

Intermediate (I): Those below the main level, which often form a sub-layer.

Oppressed (O): They are part of the bottom sub-layer. They have little vitality.

**Abundance-Coverage (A-C).** The projection of the crown or the number of individuals (only in the first two indices) was calculated, according to the modified scale of Braun Blanquet (1979). In this study, the scale from one to five was used. Each number represents a range from the A-C as discussed below. If there are two numbers, it means that the range varies between these two values. The scale is as follows:

1. Shortly rich or poor coverage. It covers up to 5% of the sample plot.

2. Little or too numerous, or coverage between 6 and 25%.

3. Coverage between 26 and 50%.

4. Coverage between 51 and 75%.

5. Seventy six percent (76%) or greater coverage.

**Presence Degree (P-D).** The existence of a species in the different sampled plots is conceived as presence. Values mean according to the number of times such species are found in the sampled plots and they are expressed in the following scale:

V. Constantly present: when species are observed in over 80% of the plots.

IV. Present most of the times: when species are found from 61 to 80%.

III. Often present: when species are found between 41 and 60%.

II. Rarely present: when species are present from 21 to 40%.

I. Rare: when species are observed in less than 20% of the plots.

**Type of participation.** It is the combination of the indices of abundance-coverage and the presence degree. It is considered as follows:

**Main species:** They are species having a presence degree of V and an abundance-coverage of two or greater.

**Subdominant species:** Species with a presence degree of V and an abundance-coverage lower than two or species with a presence degree of IV and any abundance-coverage.

**Aggregated Species:** Species with a presence degree of III, and any abundance-coverage.

**Scattered Species:** Species with a presence degree of II or I and any abundance-coverage.

**Canopy layer coverage:** It is the floor surface occupied by the horizontal projection of a plant foliage. It is calculated according to the classification of Samek (1974).

**Superdense:** When coverage is greater than 100%. The branches of some individuals enter in the space of the crowns of the neighboring individuals.

**Dense:** Coverage between 91 and 100%; branches touch each other.

**Slightly sparse:** Coverage between 81 and 90%.

**Sparse:** Coverage between 51 and 80%.

**Very sparse:** Coverage between 21 and 50%.

A coverage lower than/below the 20% corresponds to a "clearing" with scattered trees.

**Coverage of the shrub and herbaceous layers.** The percentage of each of these layers is calculated as follows:

**Very high:** Coverage between 91 and 100%.

**High:** Coverage of 51 to 90%.

**Media:** Coverage between 21 and 50%.

**Low:** Coverage below the 20%.

**Characteristic combination:** It is the set of species that characterize and typify the forest type. It is formed by main, subdominant and aggregated species. When there is a group of species that differentiates similar forest types in oecotopes with some dissimilarity, it forms a differential combination. In these combinations, constant species (those having a V presence degree), and accompanying species (those having IV and III presence degree) were differentiated.

**Oecotopes characteristics:** The oecotope is the climatope (climatic conditions) and edatope (soil conditions: higtrope and trofotope) assembly. Sites that occupy tilted areas are influenced by physiographic characteristics. They will be therefore taken into account.

**Physiographic characteristics:** These observations are made in each plot alongside its surrounding area. The following parameters are determined: elevation above sea level, type of

relief, exposure, slope in degrees, position on the slope (relative elevation) and microrelief.

**Climatope characteristics:** Sierra Maestra climatope was determined using the Borhidi (1996) bioclimate, with some modifications from Samek & Travieso (1968), Montenegro (1990, 1991a, b, c, d, e) and Trusov & *al.* (1983) in the parameters: temperature, mean multi-annual rainfall and dry months.

**Edatope characteristics:** In the plot and its surroundings, there are observed: rock and soil types, depth of solum, texture, structure, stoniness, gravelness and erosion. Besides, the organic layers (L, F and H) and soil profile are described.

The trofotope (trophism) is studied: A = little fertile, B = moderately fertile, C = fertile and D = very fertile. The higtrope (soil moisture) is also studied, which according to the Pogrebnyak method (1955, in Samek, 1973) is classified as: 0 = very dry, 1 = dry, 2 = fresh, 3 = moderately wet and 4 = wet.

The percentage of stone on the surface and the presence of dogtooth (lapiez) are classified as follows: less than 40% (<sub>x</sub>), 40 to 59% (<sub>xx</sub>), 60% or more (<sub>xxx</sub>). The root mat has a vital role in nutrient cycle in some forests types, thereby it is important to take into account writing (Rm\*) when they have up to 10 cm and (Rm\*\*) for more than 10 cm.

**Name of the forest type:** To name the forest type, it is used the common name (Appendix 1) of two typical species from the characteristic combination (constant) of that type. The first one must belong to the canopy layer (constant and dominant) followed by another typical and constant species from any stratum. To differentiate some other types of forests more or less similar, the name of a typical and constant species from the differential combination is used, and then it is added to the previous name.

Through the characteristics of the oecotopes occupying the different forest types, it is possible to determine the relative qualities of the forest station or sites, which depends on the potential productive capacity (PPC), remaining defined five classes: excellent (I); good (II); regular (III); bad (IV) and very bad (V).

For forest management proposals, it is taken into account, in addition to the above, the floristic, syngenetic and physiognomic characteristics of forests (microphyllly, mesophyllly, size, degree of coverage, etc.); as well as the development strategies (nutrients circulation type), stages of degradation and strategies for rehabilitation and / or restoration.

Scientific names (genus, species and author) are fully written in Appendix 1.

## Results and Discussion

### Climatic type

Tropical climate with two dry periods: Type of bioclimate with little extension in Sierra Maestra, due to the rain shadow of the mountains. The following subtype is observed:

5aTh. Extremely dry tropical bixeric climate: It is observed in the coastal strip (zone of wetlands and semi-deciduous microphyll forest) east of the bay of Santiago de Cuba. It is one of the most climatically extreme areas in Cuba; it rains a little less than 800 mm a year on average (arid climate); the rainy months are May, September and October exceeding 100 mm; on the contrary, the driest ones are from december to March and July, in which hardly ever the rainfall goes over 30 mm (extremely dry). The rainy days are usually less than 40 per year. Evaporation ranges from 1900 to 2000 mm (Crespo, 1989). The increased evaporation months are March, April, July and August with 130 to 140 mm (Piche) and those with minor evaporation are November and December with 85 mm (Montenegro, 1991d). Mean annual temperature ranges from 24-26°C, with a mean annual maximum of 30-32°C and a mean annual minimum of 22-24°C (Montenegro, 1991b).

Tropical climate with dry winter: This type of bioclimate is the most widespread in Sierra Maestra, with the exception of the upper parts and the coastal area in the southeast opposite side. The two following subtypes are found:

4bTh - Tropical weather with 5 to 6 scarcely rainy months (medium-dry): It is observed on the “floor of semi deciduous forests and scrubs”, longer spread to the west of the bay of Santiago de Cuba. The altitude ranges from sea level to 400-500 m asl in the northern and southern sides respectively; also, the mean annual temperature fluctuates between 24.5 and 26.0 °C and rainfall varies from 800 to 1200 mm (from low to medium rainy). Mean annual relative humidity is 75 to 80% and evaporation is 1700 to 1900 mm (Crespo, 1989; Montenegro, 1991d). To the west of the bay, rain increases gradually up to about 1200 mm (medium rainy) before Pico Turquino (where the mountains plunge straight into the sea), from this point, it gradually decreases to 800 mm near Cabo Cruz (little rainy).

4cTh - Tropical climate with 3 to 4 little rainy months (moderately dry): It is observed on the “floor of evergreen forests”, i.e., between 500 and 800 m asl. On the northern

side, mean annual temperatures range between 21.3-23.1°C (top and bottom respectively), and 21.0-24.0°C on the southern slope (Montenegro, 1991b). The rainfall ranges from 1200 to 1800 mm (medium rainy to rainy), according to the locality. Relative humidity fluctuates during the year between 77 and 85% at 500 m asl and 84 to 92% at the top (Montenegro, 1991c). In Carso de Baire, mean annual evaporation is 1300 to 1500 mm (Montenegro, 1991d). In mountainous areas below 800 m above sea level, in the evenings and in mid-april to late October, relative sunshine (percentage of real sunshine regarding the astronomical one) varies between 20 and 30%, the rest of the months is from 30 to 40%. During the mornings, it ranges from 40 to 60% (Montenegro, 1991e).

Wet mountainous tropical climate: This kind of climate occurs in higher parts of Sierra Maestra, from 800 m asl and the top of Pico Turquino (maximum elevation of the Cuban archipelago, 1972 m asl). Two subtypes are observed:

7a - Wet mountainous tropical climate: It occupies the “floor of the mountain rainforest”, i.e. between 800 and 1500 m asl. Annual rainfall is 1600-2000 mm, with a lower rainy period from November to April (Regal, 1988) and with a great influence of the horizontal precipitation: 239 days in Gran Piedra (1100 m asl; Montenegro, 1990). It is noteworthy that in this area the orographic cloud condensation occurs, which takes place between 800 and 1200 m asl; therefore, a 100% relative humidity is observed when it occurs, sometimes getting to flow through the stems (Boytel Yambú, 1972). Due to these horizontal rainfall in above 800 m asl areas (evenings), for 9 months, it does not exceed the 20% of relative sunshine, including four months in which it is less than 10%. The other months it ranges between 20 and 30%. During the mornings, it varies from 30 to 50%. Throughout the year, such relative humidity reaches high values, from over 87% to nearby 92% among different months. The mean air temperature in Gran Piedra is 18.4 °C. Therefore, evaporation is low and for eight months in the year it does not exceed 100 mm/month (Montenegro, 1991d). The zonal vegetation is mountain rainforest.

7b - Tropical climate of high mountain: This climatic type takes place on the “floor of cloud forests” from 1500 m above sea level to the top of Pico Real del Turquino (1972 m asl). The mean temperature fluctuates at 1500 m asl, between 14.1 °C and 19.3°C in january and july respectively; in turn, at the top of Turquino, it reaches about de 13°C

(Montenegro, 1991b). Rainfalls reach about 2000 mm (rainy weather). The influence of horizontal precipitations (orographic clouds and mists) is almost daily; however, on its outside, the forest experiences significant water stress due to the scarce air saturation (Reyes & Fornaris, 2011). Compared to the “floor of the mountain rainforest”, relative humidity decreases in these altitudes, averaging between 81 and 85% at 1500 m asl, and 82-83% on top of Turquino in dry and rainy periods respectively (Montenegro, 1991c). Sometimes, values of 36 and 40% are reached during the hottest hours (Reyes & al., 2011).

**Forest Typology**

Due to the wide variety of oecotopes (types of weather, rocks and soils) and physiographic

conditions (higher altitudes of the Cuban archipelago, sublatitudinal extension), Sierra Maestra has a great diversity of forest types. The main ones are:

**Uva caleta with yana (*Coccoloba uvifera* with *Conocarpus erectus*; Table 1)**

Physiognomy and floristic composition: This type of forest is known as sea-grape woodland and consists on a long and narrow tree strip dominated by *Coccoloba uvifera* (Table 1). Generally, its height does not exceed 8 m, excepting in beaches, where it can reach about 15 m. Due to the effect of the sea winds; it often forms an inclined plane, from near the ground to the appropriate height level.

Table 1. Characteristic combination of uva caleta with yana (*Coccoloba uvifera* with *Conocarpus erectus*, 6 plots)

| Species                   | Vertical structure | Abundance-Coverage | Presence Degree |
|---------------------------|--------------------|--------------------|-----------------|
| Canopy layer              |                    |                    |                 |
| <i>Coccoloba uvifera</i>  | D                  | 4                  | V               |
| <i>Conocarpus erectus</i> | D                  | 2                  | V               |

Scattered tree species: majagua de la florida (*Thespesia populnea*), ipil ipil (*Leucaena leucocephala*), vomitel (*Cordia sebestena*) and guacalote amarillo (*Caesalpinia bonduc*).

Oecotope characteristics. Due to its location near the sea, it is remarkably influenced by salt laden sea breezes (salt spray) and by the splashes during heavy swell, which changes the local climate. It is generally observed over the Cobre Group and sandy beaches; soils are sandy and gravelly, usually very shallow.

Terms for forest management. Since they protect surrounding vegetation from marine salt spray and they are a narrow strip, they must be protected against any human intervention, since they can be easily destroyed.

**Mangrove stands**

Mangroves are affected by marine and fresh water influence, which determines the corresponding type. Therefore, the local climatic conditions have their greatest impact

in the farthest areas from the sea and the estuaries.

**Red mangrove community (*Rhizophora mangle*; Table 2)**

Physiognomy and floristic composition. This community is presented as a belt between 2 and 10 m wide where there is a very straight-forward contact with the sea. It may reach higher values in flat areas. Its height is usually between 5 and 10 m and its structure is rather continuous, without defined layer. Regeneration is variable, sometimes scarce. Since it is exclusively composed by red mangrove (*Rhizophora mangle*), this forest forms a distinct ecosystem. Its anchoring aerial roots create special conditions for establishing and developing various types of fauna (Table 2).

Oecotope characteristics. It occurs in low-lying places with sediment deposition, usually in areas protected from ocean streams. It is directly in contact with the ocean waves, and the places where tide variation gets its highest values. The substrate consists of quaternary sediments whose composition varies depending on the surrounding geology.

Distribution. It takes place in all the Cuban archipelago coasts.

Terms for forest management. It must be protected from any human intervention, since it forms a narrow strip and protects the coasts and the communities behind them. There are important areas that have been destroyed and should be therefore, restored. Recovery can be made by means of the propagules, which are born in the tree (viviparous capacity).

Table 2. Characteristic combination of the red mangrove community (*Rhizophora mangle*, 10 plots)

| Species                  | Vertical structure | Abundance-Coverage | Presence Degree |
|--------------------------|--------------------|--------------------|-----------------|
| All layers               |                    |                    |                 |
| <i>Rhizophora mangle</i> | D                  | 5                  | V               |

### Community of red mangrove with black mangrove (*Rhizophora mangle* with *Avicennia germinans*; Table 3)

Physiognomy and floristic composition. In San Miguel de Paradas, bay of Santiago de Cuba, this mixed mangrove stand forms a narrow belt of up to 70 m; being lower in some other places. Such strip is only composed by red and black mangroves (*Avicennia germinans*) altogether (Table 3). Usually, the first one is more abundant before the sea. This is where it forms the bulk of the canopy layer in the first 7 to 15 m; it appears later as seedlings in a forest dominated by the second type of mangrove. The canopy layer is between 10 and 12 m tall, with a dense coverage (around 90%),

while in the shrub layer it is almost always low (5 and 10%); seedlings, on the other hand, show an average coverage from 20 to 50%.

Oecotope characteristics. They are similar to those of the red mangrove community, although with less influence of waves.

Distribution. It comes after the red mangrove community, or in direct contact with the sea; therefore, it receives alongside the former community, the strongest tidal influence and the greatest depth of water. At certain times, such a water height is of at least 20 to 30 cm at low tide.

Terms for forest management. This kind of mangrove stand should be protected from human activities due to its coastal protection functions and narrow strip condition.

Table 3. Community of red mangrove with black mangrove (*Rhizophora mangle* with *Avicennia germinans*, 10 plots)

| Species                    | Vertical structure | Abundance-Coverage | Presence Degree |
|----------------------------|--------------------|--------------------|-----------------|
| All layers                 |                    |                    |                 |
| <i>Rhizophora mangle</i>   | D                  | 3                  | V               |
| <i>Avicennia germinans</i> | D                  | 2                  | V               |

Scattered tree species: white mangrove (*Laguncularia racemosa*)

### Community of black mangrove (*Avicennia germinans*; Table 4)

Physiognomy and floristic composition. This type of mangrove stand is found throughout the study area and is generally predominant. It

is located behind the red mangrove, and/or the red with black mangrove communities. It consists of pure populations of *Avicennia germinans*, which gives it a distinctive look. It shows its greatest height in the part in contact with the community of red mangrove, where it



reaches between 10 and 12 m. Behind this point, it only reaches from 3 to 6 m and can be considered as stunted mangroves. It is considered the high density of pneumatophores, which are sometimes used as attachment points of seaweed and animals, and over which it is possible to walk easily (Table 4).

Oecotope characteristics. The soils are boggy (halomorphic) with quaternary sedi-

ments. It is located in the area of tidal fluctuation and it is completely affected during high tide.

Distribution. They can be found in all coasts of the Cuban archipelago.

Terms for forest management. It must be protected like all mangrove communities. There are significant areas affected by human impact. Such areas should be restored in order to re-establish their role as protector of the coasts and the biodiversity.

Table 4. Characteristic combination of the black mangrove community (10 plots)

| Species                    | Vertical structure | Abundance-Coverage | Presence Degree |
|----------------------------|--------------------|--------------------|-----------------|
| All layers                 |                    |                    |                 |
| <i>Avicennia germinans</i> | D                  | 5                  | V               |

**Black mangrove with acrostic (*Avicennia germinans* with *Acrostichum danaefolium*; Table 5)**

Physiognomy and floristic composition. This type of mangrove stand (Table 5) has a black mangrove canopy layer of 12 to 15 m high, with a cover from very sparse to sparse (40 to 70%). The shrub layer is of acrostic (*Acrostichum danaefolium*), which reaches about 5 to 6 m and has a cover between high and very high (51 to 100%).

Oecotope characteristics. It usually develops with freshwater influence, whose inten-

sity determines the abundance of herbs.

Distribution. It is dispersed. It was studied at the northwestern edge of the mangrove stands of San Miguel de Paradas, where intermittent streams flow which cause significant freshwater input. Furthermore, it is little influenced by the tides, due to its geographical position in the mangrove stand.

Terms for forest management. Like other mangrove communities, it should be protected from all human activity.

Table 5. Black mangrove with acrostic (*Avicennia germinans* with *Acrostichum danaefolium*, 5 plots)

| Species                        | Vertical structure | Abundance-Coverage | Presence Degree |
|--------------------------------|--------------------|--------------------|-----------------|
| Canopy layer                   |                    |                    |                 |
| <i>Avicennia germinans</i>     | D                  | 3                  | V               |
| Shrub layer                    |                    |                    |                 |
| <i>Acrostichum danaefolium</i> | -                  | 4                  | V               |

**Black mangrove community with white mangrove (*Avicennia germinans* with *Laguncularia racemosa*; Table 6)**

Physiognomy and floristic composition. This type of forest, composed by white mangrove (*Laguncularia racemosa*) and black mangrove is very poorly represented and it is known as mixed mangrove. Sometimes it is put apart from the red mangrove by salt marshes of variable size. It reaches between 4

and 10 m in height and it often has underneath, seedlings of both species (Table 6).

Oecotope characteristics. The soils are weakly flooded. In some places, they are just directly affected by salt water during high tides. They are also influenced by the rainwater.

Distribution. It is commonly seen throughout the study area.

Terms for forest management. Like other mangrove communities, it should be protected from all human activity.

Table 6. Black mangrove community with white mangrove  
(*Avicennia germinans* with *Laguncularia racemosa*, 7 plots)

| Species                      | Vertical structure | Abundance-Coverage | Presence Degree |
|------------------------------|--------------------|--------------------|-----------------|
| All layers                   |                    |                    |                 |
| <i>Avicennia germinans</i>   | D                  | 3                  | V               |
| <i>Laguncularia racemosa</i> | C                  | 1                  | V               |

Scattered tree species: yana, cambrón (*Prosopis juliflora*)

**Black mangrove with white mangrove and junco (*Avicennia germinans* with *Laguncularia racemosa* and *Eleocharis mutata*; Table 7)**

Physiognomy and floristic composition. In San Miguel de Paradas, this forest is among the mangrove stands of black mangrove and black mangrove with acrostic, i.e., it comes after the latter into the mangrove stands. In addition to the black mangrove, there is often white mangrove in the canopy layer. It is 8 to 14 m high and its covers from very sparse to sparse (21-70%). The shrub layer

has a variable cover, media (21-50%); while in the herbaceous layer is high (51-80%). This type of mangrove stand is the richest in herbaceous species (Table 7).

Oecotope characteristics. Water usually varies between 2 and 10 cm above the substrate, strongly influenced by freshwater.

Distribution. It is in the northwestern part of the mangrove stands of San Miguel de Paradas in the bay of Santiago de Cuba.

Terms for forest management. Like other mangrove communities, it should be protected from all human activity.

Table 7. Black mangrove community with white mangrove and junco  
(*Avicennia germinans* with *Laguncularia racemosa* and *Eleocharis mutata*, 7 plots)

| Species                                     | Vertical structure | Abundance-Coverage | Presence Degree |
|---|--------------------|--------------------|-----------------|
| Canopy layer                                |                    |                    |                 |
| <i>Avicennia germinans</i>                  | D                  | 3                  | V               |
| <i>Laguncularia racemosa</i>                | C                  | 1                  | III             |
| Herbaceous layer                            |                    |                    |                 |
| <i>Eleocharis mutata</i>                    | -                  | 2                  | V               |
| <i>Typha domingensis</i>                    | -                  | 2                  | V               |
| <i>Eleocharis.elegans</i>                   | -                  | 1                  | V               |
| <i>Cyperus giganteus</i>                    | -                  | 1                  | V               |
| <i>Scirpus olneyi</i>                       | -                  | 1                  | V               |
| <i>Cyperus alternifolius</i>                | -                  | 1                  | III             |
| <i>Ludwigia erecta</i>                      | -                  | 1                  | III             |
| <i>Bacopa monnieri</i> var. <i>monnieri</i> | -                  | 1                  | III             |
| <i>Alternanthera maritima</i>               | -                  | 1                  | III             |
| Lianas                                      |                    |                    |                 |
| <i>Mikania micrantha</i>                    | -                  | 1                  | III             |

Scattered tree species: yana.

### Yana community (*Conocarpus erectus*; Table 8)

Physiognomy and floristic composition. This type of mangrove stand (Table 8) is exclusively composed by yana (*Conocarpus erectus*). Stratification is continuous and dense (100%) and can reach 8 to 12 m high.

Oecotope characteristics. Usually the ground is muddy and brown. It often occupies lagoon-like channels and is usually out of tidal influence.

Distribution. It is a highly disperse mangrove stand.

Terms for forest management. Like other mangrove communities, it should be protected from all human activity.

Table 8. Yana community (*Conocarpus erectus*), 6 plots

| Species                   | Vertical structure | Abundance-Coverage | Presence Degree |
|---------------------------|--------------------|--------------------|-----------------|
| All layers                |                    |                    |                 |
| <i>Conocarpus erectus</i> | D                  | 5                  | V               |

### Jatia with no me toques (*Phyllostylon brasiliensis* with *Oplonia tetrasticha*; Table 9)

Physiognomy and floristic composition. This forest type is part of the semi-deciduous microphyll forest. The canopy layer is between 8 and 10 meters high, unusual if more. Its coverage is between 60 and 80%, and considered as scarce. Within the group of constant species, only jatia [*Phyllostylon brasiliensis* (= *Ph. rhamnoides*)] is in the category of main species; baría (*Cordia gerascanthus*), carbonero (*Colubrina elliptica*) and chicharrón (*Pseudocarpidium avicennioides*) are subdominants. In the shrub layer, with a cover considered medium to high (40-80%), no me toques (*Oplonia tetrasticha*) and *Varronia globosa* are main species; while picha de perro (*Capparis flexuosa*) and palo bronco (*Malpighia suberosa*) are subdominant species. In the herbaceous layer, cuaba de ingenio (*Croton lucidus*) is the main species, with a media average cover (20-50%). As lianas and epiphytes, bejuco san pedro (*Stigmaphyllon sagreanum*) and curujey (*Tillandsia recurvata*) are subdominant species, respectively (Table 9).

In the group of accompanying species from the canopy layer, agalla de costa (*Randia aculeata*) is observed as subdominant. Negracuba (*Thouinia patentinervis*), majaguilla (*Carpodiptera cubensis*), aceituna (*Picrodendron baccatum*) and yuraguana (*Coccothrinax gundlachii*) are aggregated species. In the shrub layer, *Pictetia mucronata*, *Tabebuia myrtifolia* and frijolillo (*Senna atomaria*) are aggregated. In the herbaceous layer, *Malpighia apiculata* is considered as subdominant, while jijira (*Harrisia eriophora*), marilope (*Turnera ulmifolia*), jibá (*Erythroxylum havanense*) and anamú (*Petiveria alliacea*) are aggregated

species. Among lianas, bejuco de purgación (*Commicarpus scandens*) is subdominant; and as aggregated species, there are bejuco angarilla (*Serjania diversifolia*), bejuco de berraco (*Chiococca alba*), amansa guapo (*Triopteris rigida*), *Cynanchum* sp. and bejuco uví (*Cissus trifoliata*). Curujey (*Tillandsia fasciculata*) and barba de indio (*T. usneoides*) are subdominant in the epiphyte synusia.

Oecotope characteristics. The altitude varies between 10 and 80 m asl with an inclination between 25 and 45 degrees and an exposure mainly southward. It is located on the bottom of the mountains, near the sea, with a varied microrelief and strongly affected by the salt-laden sea winds (salt spray). This south-coastal area of Sierra Maestra, where this forest type ("floor of semi deciduous forests and scrubs") is observed, is under the effect of the rain shadow (wind screen, Föhn effect) provoked by these mountains; which means low rainfall, very warm temperature, low relative humidity and high evaporations rate.

To the east of the bay of Santiago de Cuba, there is an extremely dry tropical bixeric climate (5aTh) and rainfall is less than 700 mm a year on average. The rainiest months are May, September and October, with more than 100 mm. The driest months are from December to March, and July, when barely exceeds the 30 mm. The rainy days are usually less than 40 per year, being one of the most climatically extreme areas Cuba's, hence, it is considered a hot climate with two dry periods and more than six months of drought. To the west of the bay, rain increases gradually, changing to tropical climate with dry winter, 4bTh subtype, semi-dry, with 5 to 6 months with little rain. Precipitation falls from 900 to about 1200 mm in front of the Pico Turquino (where the moun-

tains tumble directly into the sea), from where it gradually decreases to 800 mm near Cabo Cruz. The mean annual temperature ranges from 24 to 26 °C, with a mean maximum of 30 to 32 °C and a mean minimum of 22 to 24 °C (Montenegro, 1991b). The mean annual relative humidity varies between 75 and 80%, the mean annual at 13.00 h is 70 to 75%, and from 80 to 85% at 07:00 h

(Lapinel, 1989; Montenegro, 1991b, c). Evaporation ranges between 1900 and 2000 mm (Crespo, 1989); from March to September it is over 110 mm (Piche), March, April, July and August are the months with higher evaporation (130 to 140 mm) and November and December shows the smallest evaporation rates, 85 mm (Montenegro, 1991d).

Table 9. Characteristic combination of jatía with no me toques (*Phyllostylon brasiliensis* with *Oplonia tetrasticha*, 7 plots)

| Species                                       | Vertical structure | Abundance-Coverage | Presence Degree |
|---|--------------------|--------------------|-----------------|
| Canopy layer                                  |                    |                    |                 |
| <i>Phyllostylon brasiliensis</i>              | D                  | 4                  | V               |
| <i>Collubrina elliptica</i>                   | D                  | 1                  | V               |
| <i>Pseudocarpidium avicennioides</i>          | D                  | 1                  | V               |
| <i>Cordia gerascanthus</i>                    | C                  | 1                  | V               |
| <i>Randia aculeata</i>                        | I                  | 1                  | IV              |
| <i>Picrodendron baccatum</i>                  | C                  | 1                  | III             |
| <i>Carpodiptera cubensis</i>                  | C                  | 1                  | III             |
| <i>Thouinia patentinervis</i>                 | C                  | 1                  | III             |
| <i>Coccothrinax gundlachii</i>                | I                  | 2                  | III             |
| Shrub layer                                   |                    |                    |                 |
| <i>Oplonia tetrasticha</i>                    | -                  | 2                  | V               |
| <i>Varronia globosa</i> subsp. <i>humilis</i> | -                  | 2                  | V               |
| <i>Capparis flexuosa</i>                      | -                  | 1 to 2             | V               |
| <i>Malpighia suberosa</i>                     | -                  | 1                  | V               |
| <i>Tabebuia myrtifolia</i>                    | -                  | 1                  | III             |
| <i>Pictetia mucronata</i>                     | -                  | 1                  | III             |
| <i>Senna atomaria</i>                         | -                  | 1                  | III             |
| Herbaceous layer                              |                    |                    |                 |
| <i>Croton lucidus</i>                         | -                  | 2                  | V               |
| <i>Malpighia apiculata</i>                    | -                  | 1                  | IV              |
| <i>Harrisia eriophora</i>                     | -                  | 1                  | III             |
| <i>Turnera ulmifolia</i>                      | -                  | 1                  | III             |
| <i>Erythro xylum havanense</i>                | -                  | 1                  | III             |
| <i>Petiveria alliacea</i>                     | -                  | 1                  | III             |
| Lianas  |                    |                    |                 |
| <i>Stigmaphyllon sagreanum</i>                | -                  | 1                  | V               |
| <i>Commicarpus scandens</i>                   | -                  | 1                  | IV              |
| <i>Cynanchum</i> sp.                          | -                  | 1                  | III             |
| <i>Cissus trifoliata</i>                      | -                  | 1                  | III             |
| <i>Serjania diversifolia</i>                  | -                  | 1                  | III             |
| <i>Chiococca alba</i>                         | -                  | 1                  | III             |
| <i>Triopteris rigida</i>                      | -                  | 1                  | III             |
| Epiphytes                                     |                    |                    |                 |
| <i>Tillandsia recurvata</i>                   | -                  | 1                  | V               |
| <i>Tillandsia fasciculata</i>                 | -                  | 1                  | IV              |
| <i>Tillandsia usneoides</i>                   | -                  | 1                  | IV              |

Scattered species in the canopy layer: almácigo (*Bursera simaruba*), guásima (*Guazuma ulmifolia*), cafecillo (*Bourreria virgata*), yamaquey (*Belairia spinosa*) and aguedita (*Picramnia pentandra*).

Localities: Southern part of Sierra del Turquino.

It is geologically located on rocks from the Cobre Group (Méndez & *al.*, 1994) and associated to limestone of Jaimanitas formation. There are mainly rocks and stones from the first group, mixed with the second's ones, although the reverse situation is also observed, i.e. limestone mixed with rocks and stones of the Cobre Group. The soil is reddish brown fersiallitic (Renda, 1989; Hernández & *al.*, 1994), very shallow, often gravelly, containing stones and rocks ranging from 60 to 90%. Therefore, it can be considered as very dry (0) and little fertile (A).

Because it grows in such difficult environmental conditions (shallow soil, high rockiness, stoniness, gravelness, high temperatures, high evaporation and marine salt spray influence), this forest is much stressed, which is expressed in its microphyll, sclerophyllous and semi-deciduous character (Reyes & Acosta, 2004). Therefore, the potential productive capacity should be considered as very bad (V). The typology classification is as follows  $A_{xxx}0$ ,  $5aTh_a - 4bTh_{b-c}$ , V, Ph. b., O.t.

Distribution. This forest type had a much wider distribution in this coastal area, yet was studied in areas close to the coast of Sierra del Turquino and was observed in relatively large areas on both sides of the bay of Guantanamo and in scattered patches elsewhere.

Terms for forest management. Due to the ecological conditions in which it develops, this coastal forest has hardwood tree species and very slow growing, so handling should be especially careful. It must be protected in general, with 30-year-spaced selective interventions. Special care must be taken with regeneration, which is generally poor and scattered. There are plenty of coastal oecotopes adequate to restore this type of forest, which must be planted with jatía, as a main species, mixed with baría, almácigo, carbonero, majaguilla and negracuba. Climate change models predict increased drought in eastern Cuba (Álvarez & Mercadet & *al.*, 2012). That is why, restoring this type of forest (due to its geographical position in the landscape) constantly raises its strategic value for protecting the coastal zone and the ecosystems behind from the effects of such climate changes.

### **Carbonero with majaguilla de costa (*Colubrina elliptica* with *Helicteres semitriloba*; Table 10)**

Physiognomy and floristic composition. This forest type corresponds to a late second-

dary community of the semi-deciduous microphyll forest and is the stage *fiera* II under the conditions in which it takes place. The canopy layer is very sparse (20%), occasionally more, and the height is 7 to 8 m, in more developed areas it can reach up to 10 m. As dominant species there is carbonero, and as co-dominant (subdominant species) there are majaguilla, almácigo and cafecillo. In the shrub layer, coverage is high (70 to 90%); frijolillo and *Varronia globosa* subsp. *humilis* are the main species, while bayúa (*Zanthoxylum elephantiasis*) and picha de perro, are subdominant ones. The herbaceous layer coverage is high (60 to 70%), with cuaba de ingenio (*Croton lucidus*) as the main species with high abundance – coverage, and tapa culo (*Helicteres semitriloba*) as subdominant. Among lianas, bejuco san pedro (*Stigmaphyllon sagreanum*) and bejuco de purgación are subdominants.

The group of accompanying species is numerous. In the canopy layer, negracuba, chicharrón (*Pseudocarpidium avicennioides*), *Pictetia mucronata* and yuraguana (*Coccothrinax gundlachii*) they are subdominants, with high abundance - coverage. In the shrub layer jibá is subdominant and in the herbaceous layer, the following species are also subdominant: no me toques, palo bronco (*Malpighia suberosa*), abrojo de costa (*Castela spinosa*), *Zapoteca gracilis*, *Lantana montevidensis*, marilope (*Turnera ulmifolia*), *Crossopetalum* sp., yerba de guinea (*Urochloa humidicola*) and camagueyana (*Bothriochloa pertusa*). Barba de indio (*Tillandsia usneoides*) and curujey (*Tillandsia recurvata*) are subdominant species among the epiphytes (Table 10).

Oecotope characteristics. It occupies the upper areas of the micro-basins, where part of the rain water does not infiltrate but drains into the lower areas, hence, the hydraulic stress is very pronounced. It takes place between 70 and 120 m asl The slope is very steep, 40 to 45 degrees; exposure varies between the south and the east. A tropical climate with dry winter, subtype 4bTh, is observed with 5 to 6 months with little rain (semi-dry). The mean annual temperature ranges from 24-26°C, with average picks of 30-32°C and 22-24°C respectively. The mean annual relative humidity is 75 to 80%, this being 70 to 75% at 13:00 h and from 80 to 85% at 07:00 h. Evaporations rate is 1700-1900 mm (Montenegro, 1991b, c, d). It rains about 1000 mm, with a little rainy season from November to April and a rainy season from May to October. It is therefore considered a hot tropical climate with dry and semi-dry winter,

with 5-6 dry months. Commonly, it is strongly affected by salt spray sea breezes.

Geologically, it is observed on rocks from the Cobre Group (Méndez & *al.*, 1994). The soil is fersiallitic reddish brown (Renda, 1989), yellowish, very shallow, very gravelly, highly eroded and has truncated profiles; the amount of stones on the surface is 60 to 90%.

For all the difficult conditions of the oecotope: topographic position, soil, hydraulic stress, etc, this type of forest grows under extreme conditions, which is expressed in its microphyll and sclerophyllous nature. Therefore, it is considered as very dry (0) and little fertile (A). The typology classification is A<sub>xxx</sub>0, 4bTh<sub>b</sub>, V, C.e., H.s.

Table 10. Characteristic combination of carbonero with majaguilla de costa (*Colubrina elliptica* with *Helicteres semitriloba*, 3 plots)

| Species                                       | Vertical structure | Abundance-Coverage | Presence Degree |
|---|--------------------|--------------------|-----------------|
| Canopy layer                                  |                    |                    |                 |
| <i>Colubrina elliptica</i>                    | D                  | 2-5                | V               |
| <i>Carpodiptera cubensis</i>                  | C                  | 1                  | V               |
| <i>Bursera simaruba</i>                       | C                  | 1                  | V               |
| <i>Bourreria virgata</i>                      | C                  | 1                  | V               |
| <i>Thouinia patentinervis</i>                 | C                  | 4                  | IV              |
| <i>Pseudocarpidium avicennioides</i>          | C                  | 4                  | IV              |
| <i>Pictetia mucronata</i>                     | I                  | 4                  | IV              |
| <i>Coccothrinax gundlachii</i>                | I                  | 4                  | IV              |
| Shrub layer                                   |                    |                    |                 |
| <i>Senna atomaria</i>                         | -                  | 2                  | V               |
| <i>Varronia globosa</i> subsp. <i>humilis</i> | -                  | 2                  | V               |
| <i>Zanthoxylum elephantiasis</i>              | -                  | 1                  | V               |
| <i>Capparis flexuosa</i>                      | -                  | 1                  | V               |
| <i>Erythroxylum havanense</i>                 | -                  | 1                  | IV              |
| Herbaceous layer                              |                    |                    |                 |
| <i>Croton lucidus</i>                         | -                  | 3                  | V               |
| <i>Helicteres semitriloba</i>                 | -                  | 1                  | V               |
| <i>Oplonia tetrasticha</i>                    | -                  | 1                  | IV              |
| <i>Malphigia suberosa</i>                     | -                  | 1                  | IV              |
| <i>Castela spinosa</i>                        | -                  | 1                  | IV              |
| <i>Zapoteca gracilis</i>                      | -                  | 1                  | IV              |
| <i>Lantana montevidensis</i>                  | -                  | 1                  | IV              |
| <i>Turnera ulmifolia</i>                      | -                  | 1                  | IV              |
| <i>Crossopetalum</i> sp.                      | -                  | 1                  | IV              |
| <i>Urochloa humidicola</i>                    | -                  | 1                  | IV              |
| <i>Bothriochloa pertusa</i>                   | -                  | 2                  | IV              |
| Lianas  |                    |                    |                 |
| <i>Stigmaphyllon sagreanum</i>                | -                  | 1                  | V               |
| <i>Commicarpus scandens</i>                   | -                  | 1                  | V               |
| Epiphytes                                     |                    |                    |                 |
| <i>Tillandsia usneoides</i>                   | -                  | 1                  | IV              |
| <i>Tillandsia recurvata</i>                   | -                  | 1                  | IV              |

Scattered species in the canopy layer: yarúa (*Caesalpinia violacea*), lirio santana (*Exostema caribaeum*) and jatía. Localities: in the pre mountain area of the southern slope of Sierra del Turquino.

Distribution: It covers the bottom of the southern slope of Sierra del Turquino.

Terms for forest management. As it is a late secondary community with such difficult topographic and ecological conditions it must be protected, with the primary objective of preservation of the soil, the water and the micro-basins.

**Cuyá with guairaje (*Sideroxylon salicifolium* with *Eugenia maleolens*; Table 11)**

Physiognomy and floristic composition. Even when it has been relatively anthropized, the canopy layer of this semideciduous microphyll forest has between 8 and 12 m tall in its highest extension; exceptionally from 7 to 8 m with emerging from about 10 m. Coverage is sparse to dense (70-100%). In the group of constant species, the main species are: cuyá (*Sideroxylon salicifolium*), almácigo, yaití and guairaje (*Eugenia maleolens*). As subdominant species, there are: ciguilla (*Guettarda elliptica*), lirio santana and carbonero. In the shrub layer, whose cover is high (50-80%), the subdominant species are yuraguana (*Coccothrina fragans*), cuabilla, carne de vaca (*Maytenus buxifolia*) and yarúa de costa (*Erythroxylum rotundifolium*); and in the herbaceous layer (medium cover), the subdominant is the jibá. There are different species among lianas (Table 11). In the group of accompanying species, in the canopy layer: yaya (*Oxandra lanceolata*), ipil ipil, guatapaná (*Acacia macracantha*) and macaguey (toad) (*Guapira obtusata*) are subdominant species. The shrub layer is poor and the herbaceous relatively rich (Table 11). Aggregated species are concentrated in the shrub and herbaceous layers and in the lianas synusiae.

Oecotope characteristics. The elevation is 40 to 80 m a.s.l, but not directly facing the sea. It is usually found on slopes of 28 from 40 degrees and exposure is to the north (NE to

NW), so it is protected from the marine salt spray.

In this area, rainfall is about 800 mm, mainly concentrated from may to october; in turn, the humidity is low and temperatures and sunshine are very high, causing a large evaporation (Montenegro, 1991a, b, e; Crespo, 1989). It is considered as the beginning of the tropical climate zone with dry winter, semidry 4bTh subtype, with 5 to 6 months with little rain.

It is developed on marls from La Cruz formation. Soils are siallitic brown (sensu Hernández & al., 1994), loamy, from very shallow to shallow, sometimes with gravel from the marl. Therefore this edatope must be considered dry (1) and little fertile (A), and the potential production capacity is considered bad (IV). The typology classification is as follows A1, 4bTh<sub>b</sub>, IV, S.s., E.m.

Due to the steep slope, the withered leaves cover about 60% of the surface. It often accumulates in the anterior part of the stem, where it is thicker. The L layer ranges between 1 and 1.5 cm. The F layer is about 0.5 cm, but before the stems, it sometimes may be 1.0 cm. The H layer is missing (Reyes & Martinez, 2005).

Distribution. It is located in the coastal hills around the bay of Santiago de Cuba, in the south coastal terraces of Sierra Maestra (Núñez & Viña, 1989).

Terms for forest management. According to the ecological conditions in which it develops, this coastal forest has semi-hard and hardwood tree species, as well as slow and very slow growing. Therefore, it should be carefully managed. It should be preserved for being an ecosystem of great importance for coastal protection. Interventions should be selective and spaced at least, 30 years. Regeneration should be protected, since it is generally dispersed. There are oecotopes showing adequate conditions to restore this kind of forest. They should be planted cuyá, jatía, almácigo, baría, carbonero, lirio santana and yarúa (*Caesalpinia violacea*).

Table 11. Characteristic combination of cuyá with guairaje (*Sideroxylon salicifolium* with *Eugenia maleolens*, 5 plots)

| Species   | Vertical structure | Abundance-Coverage | Presence Degree |
|---|--------------------|--------------------|-----------------|
| Canopy layer  |                    |                    |                 |
| <i>Sideroxylon salicifolium</i> ( <i>Dipholis salicifolia</i> ) | D                  | 2                  | V               |
| <i>Bursera simaruba</i>   | D                  | 2                  | V               |
| <i>Gymnanthes lucida</i>  | I                  | 2                  | V               |
| <i>Eugenia maleolens</i>  | I                  | 3                  | V               |
| <i>Guettarda elliptica</i>                                      | I                  | 1                  | V               |
| <i>Exostema caribaeum</i>                                       | I                  | 1                  | V               |
| <i>Colubrina elliptica</i>                                      | I                  | 1                  | V               |
| <i>Oxandra lanceolata</i>                                       | I                  | 1                  | IV              |
| <i>Leucaena leucocephala</i>                                    | I                  | 2                  | IV              |
| <i>Guapira obtusata</i>   | I                  | 1                  | IV              |
| <i>Acacia macracantha</i>                                       | O                  | 1                  | IV              |
| Shrub layer   |                    |                    |                 |
| <i>Randia aculeata</i>  | -                  | 1                  | V               |
| <i>Coccolobos fragans</i>                                       | -                  | 1                  | V               |
| <i>Amyris elemifera</i>   | -                  | 1                  | V               |
| <i>Maytenus buxifolia</i>                                       | -                  | 1                  | V               |
| <i>Erythroxylum rotundifolium</i>                               | -                  | 1                  | V               |
| Herbaceous layer  |                    |                    |                 |
| <i>Erythroxylum havanense</i>                                   | -                  | 1                  | V               |
| <i>Randia spinifex</i>  | -                  | 1                  | IV              |
| <i>Melicoccus bijugatus</i>                                     | -                  | 1                  | IV              |
| <i>Croton lucidus</i>   | -                  | 1                  | IV              |
| <i>Drypetes</i> sp.   | -                  | 1                  | IV              |
| <i>Scleria lithosperma</i>                                      | -                  | 1                  | IV              |
| <i>Panicum</i> sp.  | -                  | 1                  | IV              |
| <i>Zanthoxylum fagara</i>                                       | -                  | 1                  | III             |
| <i>Celtis trinervia</i>   | -                  | 1                  | III             |
| <i>Thouinia trifoliata</i>                                      | -                  | 1                  | III             |
| <i>Canella winterana</i>  | -                  | 1                  | III             |
| <i>Ravenia leonis</i>   | -                  | 2                  | III             |
| <i>Zapoteca gracilis</i>  | -                  | 1                  | III             |
| Lianas  |                    |                    |                 |
| <i>Chiococca alba</i>   | -                  | 1                  | V               |
| <i>Smilax havanensis</i>  | -                  | 1                  | V               |
| <i>Stigmaphyllon sagreanum</i>                                  | -                  | 1                  | V               |
| <i>Passiflora suberosa</i>                                      | -                  | 1                  | V               |
| <i>Capparis flexuosa</i>  | -                  | 1                  | IV              |
| <i>C. cynophallophora</i>                                       | -                  | 1                  | IV              |
| <i>Lasiacis divaricata</i>                                      | -                  | 1                  | IV              |
| <i>Gouania lupuloides</i>                                       | -                  | 1                  | III             |
| <i>Capparis grisebachii</i>                                     | -                  | 1                  | III             |
| <i>Dalechampia scandens</i>                                     | -                  | 1                  | III             |

Scattered species in the canopy layer: aguadita (*Picramnia pentandra*), peonía (*Citharexylum* sp.), yarúa, roble prieto (*Ehretia tinifolia*), *Licaria* sp., abey macho (*Jacaranda coerulea*) and espuela de caballero (*Bucida spinosa*).



**Macaguey (toad) with curujey and chicharrón (*Guapira obtusata* with *Hohenbergia penduliflora* and *Drypetes mucronata*; Table 12)**

Physiognomy and floristic composition. The canopy layer is irregular in height, usually between 7 and 12 m, its cover is sparse (50-60%) and is considered a clear microphyll evergreen forest; the leaves are mainly xeromorphic and mostly microphyllous. In the group of constant species the macaguey (toad) is the main specie, and as subdominant there are lirio amarillo or suchel (*Plumeria emarginata*), ayúa de sierra (*Zanthoxylum cubense*), chicharrón (*Drypetes mucronata*), bone (*Drypetes alba*), yuraguana (*Coccothrinax elegans*) and *Tabebuia bibracteolata*. The shrub layer has a medium to high covers (30-60%), occasionally less. The subdominant species are sigua (*Ocotea coriacea*), hicaquillo (*Savia bahamensis*) and yarúa de costa (*Erythroxylum rotundifolium*). The herbaceous layer, in which there are many species considered as epiphytes in other ecosystems, has a high cover (80-90%). The main species are maguey (*Agave underwoodii*), no me toques, curujey (*Hohenbergia penduliflora*), curujey (*Tillandsia fasciculata*), and as subdominant, flor del cáliz (*Selenicereus grandiflorus*), jijira (*Pilosocereus brooksianus*), bejuco lombricero (*Philodendron lacerum*), *Polypodium polypodioides*, *Epidendrum pygmaeum* and flor de san pedro (*Epidendrum nocturnum*). In the lianas, bejuco de berraco, alambriillo (*Smilax havanensis*), bejuco san pedro, *Platygyne dentata* and bejuco manteca (*Passiflora penduliflora*) are subdominants. Among the epiphytes the main species is barba de indio and the curujeyes (*Tillandsia recurvata* and *T. pruinosa*) are subdominants.

In the group of accompanying species, the subdominants in canopy layer are: carbonero, carmín (*Alvaradoa arborescens*) and cuabilla (*Amyris elemifera*). In turn, in the shrub layer aguedita (*Celtis trinervia*), cuaba prieta (*Erithalis fruticosa*), negracuba, yaiti (*Gymnanthes lucida*), brasil (*Caesalpinia vesicaria*) and picha jutía (*Hyperbaena paucinervis*) have the same category; as well as aguedita (*Picramnia pentandra*), cañuela (*Cyrtopodium punctatum*), disciplinilla (*Rhipsalis cassutha*), among others within the herbaceous layer. Aggregated species are also diverse (Table 12).

This kind of forest have a rich differential combination that distinguish it from macaguey (toad) with curujey and lirio santana (*Guapira obtusata* with *Hohenbergia penduliflora* and *Exostema caribaeum*) (Table 11), due to some rain and altitudinal differences.

Oecotope characteristics. This kind of forest is present at the top of the mogotes (karstic dome hill) with a 600 to 670 m asl altitude. The microrelief is diverse, composed by big, sharp, with lots of holes and ruptures dogtooth rocks. The average exposure to sun light in this zone is of 3 to 5 hours per day, with lower and higher peaks during the rainy and dry seasons respectively. The mean annual temperature is 20-22°C, with a mean minimum of 16-18°C and a mean maximum of 26-28°C (Montenegro, 1991b, e). The climate is tropical with 4cTh subtype dry winter and 3 to 4 months with little rain (moderately dry), the average rainfall is 1634 mm in La Tabla (1216 to 2320 mm), so it can be regarded as rainy (sensu Borhidi, 1991). On average there are 94 rainy days in the year. A rainy season is clearly defined from march to october with 85% of the rainfall while the dry season takes only the 15% of it. The mean annual relative humidity is 80-85%, ranging between a 60-70% at 13.00 h, and 85-90% at 07.00 h (Montenegro, 1991c, d). The mean annual evaporation is 1300 to 1500 mm, with a daily average of 2.5-3 mm (Piche) and up to 3.5-4 mm in sunny days (Montenegro, 1991d).

These mogotes are strongly carsified and dissected denude plateaus (Viña Bayes, 1991), with vertical walls, composed by limestones and marbles from Charco Redondo formation. Because of its topographic position, this forest is in a very irregular microrelief, with big, sharp, with lots of holes and ruptures dogtooth rocks, where sometimes there is a red, very shallow soil. That is why it is considered dry (1), with a little fertile (A) trophism.

However, withered leaves accumulates in the holes, sometimes reaching up to 20 cm, and form a root mat, where nutrient recycling takes place. The ecosystem depends on this recycling. Due to the particular conditions of this forest, the potential productive capacity is considered very bad (V). The typology classification is as follows A<sub>xxx</sub>1, 4cTH<sub>d</sub>, V, G.o., H.p., D.m.

Distribution. This area of mogotes, where this forest type develops, occurs in the northern slope of Sierra Maestra, forming the central part of a typical territory known as Carso de Baire (La Tabla, Palma del Perro).

Terms for forest management. Due to the difficult environmental conditions where these forests evolved and their topographical position, the hardwood species with a very slow growth predominate. Therefore, it is considered a typical object of conservation and should not be exploited at any circumstances.

Table 12. Characteristic combination of macaguey (toad) with curujey and chicharrón  
(*Guapira obtusata* with *Hohenbergia penduliflora* and *Drypetes mucronata*, 4 plots)

| Species   | Vertical structure | Abundance-Coverage | Presence Degree |
|---|--------------------|--------------------|-----------------|
| Canopy layer  |                    |                    |                 |
| <i>Guapira obtusata</i>   | D                  | 2-3                | V               |
| <i>Zanthoxylum cubense</i>  | C                  | 1                  | V               |
| <i>Drypetes alba</i>  | C                  | 1                  | V               |
| <i>Coccothrinax elegans</i>   | I                  | 1                  | V               |
| <i>Tabebuia bibracteolata</i>   | I                  | 1                  | V               |
| <i>Plumeria emarginata</i>  | I                  | 1                  | V               |
| <i>Colubrina elliptica</i>  | I                  | 1                  | IV              |
| <i>Alvaradoa arborescens</i>  | I                  | 1                  | IV              |
| <i>Amyris elemifera</i>   | I                  | 2                  | IV              |
| <i>Spirotecoma</i> sp.  | O                  | 1                  | III             |
| Shrub layer   |                    |                    |                 |
| <i>Ocotea coriacea</i>  | -                  | 1                  | V               |
| <i>Savia bahamensis</i>   | -                  | 1                  | V               |
| <i>Celtis trinervia</i>   | -                  | 1                  | IV              |
| <i>Hyperbaena paucinervis</i>   | -                  | 1                  | IV              |
| Herbaceous layer  |                    |                    |                 |
| <i>Agave underwoodii</i>  | -                  | 3                  | V               |
| <i>Hohenbergia penduliflora</i>   | -                  | 3                  | V               |
| <i>Tillandsia fasciculata</i>   | -                  | 3                  | V               |
| <i>Oplonia tetrasticha</i>  | -                  | 2                  | V               |
| <i>Pilosocereus brooksianus</i>   | -                  | 1                  | V               |
| <i>Philodendron lacerum</i>   | -                  | 1                  | V               |
| <i>Selenicereus grandiflorus</i>  | -                  | 1                  | V               |
| <i>Epidendrum nocturnum</i>   | -                  | 1                  | V               |
| <i>Grisebachianthus plucheoides</i>                                       | -                  | 1                  | IV              |
| <i>Zamia angustifolia</i>   | -                  | 1                  | IV              |
| <i>Vanilla</i> sp.  | -                  | 1                  | IV              |
| <i>Arthrostylidium angustifolium</i>                                      | -                  | 2                  | IV              |
| <i>Croton lucidus</i>   | -                  | 1                  | III             |
| <i>Vernonia</i> sp.   | -                  | 1                  | III             |
| <i>Ilex</i> sp.   | -                  | 1                  | III             |
| <i>Pharus glaber</i>  | -                  | 1                  | III             |
| Lianas  |                    |                    |                 |
| <i>Smilax havanensis</i>  | -                  | 1                  | V               |
| <i>Chiococca alba</i>   | -                  | 1                  | V               |
| <i>Stigmaphyllon sagreanum</i>  | -                  | 1                  | V               |
| <i>Platygyne dentata</i>  | -                  | 1                  | V               |
| <i>Capparis flexuosa</i>  | -                  | 1                  | III             |
| <i>Cynanchum</i> sp.  | -                  | 1                  | III             |
| Epiphytes   |                    |                    |                 |
| <i>Tillandsia usneoides</i>   | -                  | 2                  | V               |
| <i>Tillandsia recurvata</i>   | -                  | 1                  | V               |
| Differential combination from macaguey (toad) with curujey and chicharrón |                    |                    |                 |
| <i>Drypetes mucronata</i>   | C                  | 1                  | V               |
| <i>Erythroxylum rotundifolium</i>   | -                  | 1                  | V               |
| <i>Polypodium polypodioides</i>   | -                  | 1                  | V               |
| <i>Epidendrum pygmaeum</i>  | -                  | 1                  | V               |
| <i>Passiflora penduliflora</i>  | -                  | 1                  | V               |
| <i>Tillandsia pruinosa</i>  | -                  | 1                  | V               |
| <i>Erithalis fruticosa</i>  | -                  | 1                  | IV              |
| <i>Thouinia trifoliata</i>  | -                  | 1                  | IV              |

|                                  |   |   |     |
|----------------------------------|---|---|-----|
| <i>Gymnanthes lucida</i>         | - | 1 | IV  |
| <i>Caesalpinia vesicaria</i>     | - | 1 | IV  |
| <i>Picramnia pentandra</i>       | - | 1 | IV  |
| <i>Trichocentrum undulatum</i>   | - | 1 | IV  |
| <i>Cyrtopodium punctatum</i>     | - | 1 | IV  |
| <i>Rhipsalis cassutha</i>        | - | 1 | IV  |
| <i>Polypodium aureum</i>         | - | 1 | IV  |
| <i>Encyclia</i> sp.              | - | 1 | IV  |
| <i>Octomeria tridentata</i>      | - | 1 | IV  |
| <i>Pleurothallis gelida</i>      | - | 1 | IV  |
| <i>Campiloneurum phyllitidis</i> | - | 1 | IV  |
| <i>Gesneria heterochroa</i>      | - | 1 | III |
| <i>Auerodendron cubensis</i>     | - | 1 | III |
| <i>Solandra longiflora</i>       | - | 1 | III |
| <i>Isidorea polyneura</i>        | - | 1 | III |
| <i>Peperomia rotundifolia</i>    | - | 1 | III |
| <i>Guzmania monostachya</i>      | - | 1 | III |
| <i>Tillandsia schiediana</i>     | - | 1 | III |
| <i>T. balbisiana</i>             | - | 1 | III |

Scattered species in the canopy layer: jaguey (*Ficus laevigata*), ramon cow (*Dendropanax arboreus*), lirio santana and jaguey (*Ficus perforata*).

Localities: Carso de Baire.

### **Macaguey (toad) with curujey and lirio santana (*Guapira obtusata* with *Hohenbergia penduliflora* and *Exostema caribaeum*; Table 13)**

Physiognomy and floristic composition. The canopy layer of this clear-microphyll evergreen forest varies between 7 and 12 m in height and its cover is sparse (50-60%). In the group of constant species, the main species is macaguey (toad) and the subdominants are yuraguana (*Coccothrinax elegans*) and *Tabebuia bibracteolata*. In the shrub layer, with variable coverage between low and high (15 and 80%), is only subdominant sigua (*Ocotea coriacea*). In the herbaceous layer, with a high cover (50 and 80%), no me toques and curujeyes (*Hohenbergia penduliflora* and *Tillandsia fasciculata*) are the main species. Concerning lianas, alambriillo, bejuco de ver-raco, bejuco lombricero and flor del cáliz are subdominants. In the group accompanying species, in the canopy layer, cuabilla, bone and suchel are subdominants. Other species from the shrub and herbaceous layers, and lianas are found in Table 13. In the canopy layer, among the aggregate species group, there are ayúa de sierra (*Zanthoxylum cubense*), carmín and few species in other strata and synusiaes. Also, lirio santana (*Exostema caribaeum*), panetela (*Phyllanthus epiphyllanthus*) and pasionaria de cerca (*Passiflora sexflora*) are present in the differential combination.

Oecotope characteristics. Because it is also developed in the top of the mogotes of Carso de Baire, the ecological conditions and forest management are the same of the forest previously described [macaguey (toad) with curujey and chicharron]. However, there are some differences in its distribution, since this forest is located in Las Manuelas and in La Pimienta. Thus, it is somewhat lower and higher than the other described forest, respectively, which may result in some rainfall differences. The typology classification is as follows  $A_{xxx}1$ ,  $4cTh_d$ , V, G.o., H.p., E.c.

### **Sigua with carmín (*Ocotea coriacea* with *Alvaradoa arborescens*)**

Physiognomy and floristic composition. This type of forest (2 plots) is an early community; it comes from excessive disturbance and fire, so it is currently a homeostasis I. Carmín (*Alvaradoa arborescens*) is the main species that make the current stability. The canopy layer is quite uneven, with a height between 6 and 11 m; the coverage is sparse, ranging between 60 and 70%. The most abundant species are carmín (D, A-C 3-4), sigua (D, A-C 1-2) and sometimes lirio amarillo (C, A-C 1), macaguey (toad) (I, A-C 1), ayúa de sierra (I, A-C 1), picha jutía (*Hyperbaena paucinervis*, 0, A-C 1), penda (I, A-C 1), lirio santana (I, A-C 1), carbonero (I, A-C 1) and

guamá (*Lonchocarpus longipes*, 0, A-C 1) are also seen in this layer. Other scattered tree species are: raspalengua (*Casearia hirsuta*), aguedita sweet, aguedita (*Picramnia pentandra*), yaití, cuabilla and pole box (*Allophylus cominia*).

In the shrub layer, coverage is high (50-60%), and it is media at the herbaceous (30-40%), which is also the richest in species.

Table 13. Characteristic combination of the forest macaguey (toad) with curujey and lirio santana (*Guapira obtusata* with *Hohenbergia penduliflora* and *Exostema caribaeum*, 5 plots)

| Species  | Vertical structure | Abundance-Coverage | Presence Degree |
|--|--------------------|--------------------|-----------------|
| Canopy layer   |                    |                    |                 |
| <i>Guapira obtusata</i>  | D                  | 3                  | V               |
| <i>Coccothrinax elegans</i>  | C                  | 1                  | V               |
| <i>Tabebuia bibracteolata</i>  | I                  | 1                  | V               |
| <i>Amyris elemifera</i>  | I                  | 1                  | IV              |
| <i>Hyperbaena paucinervis</i>  | O                  | 1                  | IV              |
| <i>Drypetes alba</i>   | O                  | 1                  | IV              |
| <i>Plumeria emarginata</i>   | O                  | 1                  | IV              |
| <i>Zanthoxylum cubense</i>   | C                  | 1                  | III             |
| <i>Alvaradoa arborescens</i>   | I                  | 1                  | III             |
| Shrub layer  |                    |                    |                 |
| <i>Ocotea coriacea</i>   | -                  | 1                  | V               |
| <i>Savia bahamensis</i>  | -                  | 1                  | III             |
| Herbaceous layer   |                    |                    |                 |
| <i>Oplonia tetrasticha</i>   | -                  | 2                  | V               |
| <i>Hohenbergia penduliflora</i>  | -                  | 2                  | V               |
| <i>Tillandsia fasciculata</i>  | -                  | 2                  | V               |
| <i>Agave underwoodii</i>   | -                  | 2                  | IV              |
| <i>Vernonia</i> sp.  | -                  | 1                  | IV              |
| <i>Grisebachianthus plucheoides</i>  | -                  | 1                  | IV              |
| <i>Pilosocereus brooksianus</i>  | -                  | 1                  | IV              |
| <i>Epidendrum nocturnum</i>  | -                  | 1                  | III             |
| Lianas   |                    |                    |                 |
| <i>Philodendron lacerum</i>  | -                  | 1                  | V               |
| <i>Selenicereus grandiflorus</i>   | -                  | 1                  | V               |
| <i>Smilax havanensis</i>   | -                  | 1                  | V               |
| <i>Chiococca alba</i>  | -                  | 1                  | V               |
| <i>Vanilla</i> sp.   | -                  | 1                  | III             |
| <i>Stigmaphyllon sagreanum</i>   | -                  | 1                  | III             |
| Epiphytes  |                    |                    |                 |
| <i>Tillandsia usneoides</i> L.   | -                  | 1                  | IV              |
| Differential combination from macaguey (toad) with curujey and lirio santana |                    |                    |                 |
| <i>Exostema caribaeum</i>  | -                  | 1                  | III             |
| <i>Phyllanthus epiphyllanthus</i>  | -                  | 1                  | III             |
| <i>Passiflora sexflora</i>   | -                  | 1                  | III             |

Scattered species in the canopy layer: baría, mabó de sabana (*Cameraria retusa*), penda (*Citharexylum caudatum*), carbonero and guairaje (*Eugenia asperifolia*).

Ecology and distribution. It comes on top of the strongly dissected carsified plateaus, mogotes, which occupies the geographical area known as Carso de Baire. The altitude varies between 600 and 650 m asl. Weather conditions are described in macaguey (toad) with curujey and chicharrón, since they are located in the same territory. Although it is at the top of the mogotes, it occupies the edatopes with shallow to very shallow soils, with about 40% of rocks on the surface. Because of its topographic position, it is exposed to the average climatic conditions of the region. The L layer is variable in site, it ranges between 0.5 to 2 cm, the F layer fluctuates from 0.2 to 1 cm and the H layer occasionally it reaches 1.5 cm, with rootlets.

As the general conditions are similar to macaguey (toad) with curujey and chicharrón, therefore it is also considered a typical object of conservation and should not be exploited at any circumstances. The typology classification is considered B1, 4cTh<sub>p</sub>, IV, O.c., A.b.

**Jocuma with guao (*Sideroxylum foetidissimum* subsp. *foetidissimum* with *Comocladia dentata*; Table 14)**

Physiognomy and floristic composition. This semideciduous microphyll forest was altered by intense selective logging, which has changed its structure. However, it maintains its floristic composition; therefore, nowadays, it can be rehabilitated.

The canopy layer is between 7 and 10 m in height, so it is considered a low forest. It has also emerging about 15 m. Cover is very sparse (30-50%). The main species are jocuma (*Sideroxylon foetidissimum* subsp. *foetidissimum*) and guao (*Comocladia dentata*). The predominant species are almácigo, sigua (sometimes abundant), cuyá, lirio santana (locally abundant), guara (*Cupania glabra*), jía blanca (*Adelia ricinella*) and aroma blanca (*Alvaradoa amorphoides*). In the canopy layer of the group of accompanying species, yaicuaaje (*Exothea paniculata*) is subdominant.

The shrub layer has a high cover (80 to 90%). Subdominant and abundant are guairaja (*Eugenia* sp.) and guao, there are too raspalengua and the jibá, among others species. In the herbaceous layer with an average from 20 to 30%, are present *Zapoteca gracilis*, amor seco (*Desmodium incanum*), cortadera (*Scleria lithosperma*) and canutillo (*Commelina elegans*). Lianas are diverse. The composition of the other strata and synusiaes (which are many) is found in Table 14.

Oecotope characteristics. This forest is present in small altitudes, between 230 and 240 m asl. The slope is small, about 5 degrees, with a relatively uniform meso and microrelief. The exposure is varied. Climatically, it is in the area where the influence of Sierra Maestra ends. It has a tropical climate with dry winter, 4bTh subtype, with 5 to 6 months with little rain (semidry). In the area, it rains between 1000 and 1200 mm (medium rainy), distributed in a rainy season from May to October, and a less rainy from November to April. It has from 40 to 60 days with precipitation annually. The mean relative humidity is 75 to 80% (Montenegro, 1991b, c) and evaporation varies between 2000 and 2200 mm (Crespo, 1989). The mean annual temperature ranges from 24-26°C, with an average high of 32-34°C and an average low of 18-20°C.

It occurs in limestone from Charco Redondo geological formation. The soil is brown, very shallow, sometimes rocks cover up to 80% of the surface. Withered leaves have an L layer between 2 and 2.5 cm, and an F layer of 0.5 to 1 cm. The H layer is thin and forms a root mat of around 1 cm in some places. It is hence considered as a dry and moderately fertile edatope. Therefore, its potential productive capacity is considered bad (IV). The typology classification is as follows B1, 4bTH<sub>p</sub>, IV, Rm\*, S.f.f., C.d.

Distribution. This forest has a more widespread distribution in the hills of the northern slope of Sierra Maestra. It was studied at the place known as El Granizo, between Jiguaní and Baire, in the hills of northern edge of Sierra Maestra.

Terms for forest management. As intervention continues, this forest has lost part of its structure. However, there are many valuable species from the forestry point of view, which have an acceptable participation in the canopy layer and a very good regeneration (jocuma, cuyá, sigua, guara, yaicuaaje). Therefore, interventions should be limited to restrict guao and frijolillo in the canopy layer and release the seedlings of the most valuable species in the lower ones. It can be also enriched with mahogany (*Swietenia mahagoni*), cedar (*Cedrela odorata*), yarúa, etc.

**Group of cuyá with cúrbana (*Sideroxylon salicifolium* with *Canella winterana*)**

Physiognomy and floristic composition. This forest type consists of three stages of successional development corresponding to a late community (sensu Budowski, 1985; Capote & al., 1988; Reyes & Acosta, 2005). Differences

Table 14. Characteristic combination of jocuma with guao  
(*Sideroxylon foetidissimum* subsp. *foetidissimum* with *Comocladia dentata*, 3 plots)

| Species  | Vertical structure | Abundance-Coverage | Presence Degree |
|--|--------------------|--------------------|-----------------|
| Canopy layer   |                    |                    |                 |
| <i>Sideroxylon foetidissimum</i> subsp. <i>foetidissimum</i> | P                  | 3                  | V               |
| <i>Comocladia dentata</i>                                    | D                  | 2                  | V               |
| <i>Bursera simaruba</i>                                      | P                  | 1                  | V               |
| <i>Sideroxylon salicifolium</i>                              | C                  | 1                  | V               |
| <i>Ocotea coriacea</i>                                       | C                  | 1                  | V               |
| <i>Exostema caribaeum</i>                                    | C                  | 1                  | V               |
| <i>Cupania glabra</i>  | C                  | 1                  | V               |
| <i>Adelia ricinella</i>                                      | O                  | 1                  | V               |
| <i>Alvaradoa amorphoides</i>                                 | O                  | 1                  | V               |
| <i>Exothea paniculata</i>                                    | C                  | 1                  | IV              |
| Shrub layer  |                    |                    |                 |
| <i>Eugenia</i> sp.   | -                  | 3                  | V               |
| <i>Picramnia pentandra</i>                                   | -                  | 1                  | V               |
| <i>Casearia hirsuta</i>                                      | -                  | 1                  | V               |
| <i>Erythroxylum havanense</i>                                | -                  | 1                  | V               |
| <i>E. rotundifolium</i>                                      | -                  | 1                  | V               |
| <i>Varronia globosa</i>                                      | -                  | 1                  | V               |
| <i>Capparis flexuosa</i>                                     | -                  | 1                  | IV              |
| <i>Coccoloba diversifolia</i>                                | -                  | 1                  | IV              |
| <i>Erithalis fruticosa</i>                                   | -                  | 1                  | IV              |
| <i>Chrysophyllum oliviforme</i>                              | -                  | 1                  | IV              |
| <i>Guettarda</i> sp.   | -                  | 1                  | IV              |
| <i>Senna atomaria</i>  | -                  | 1                  | IV              |
| <i>Zanthoxylum fagara</i>                                    | -                  | 1                  | IV              |
| Herbaceous layer   |                    |                    |                 |
| <i>Desmodium incanum</i>                                     | -                  | 1                  | V               |
| <i>Zapoteca gracilis</i>                                     | -                  | 1                  | V               |
| <i>Scleria lithosperma</i>                                   | -                  | 1                  | V               |
| <i>Commelina elegans</i>                                     | -                  | 1                  | V               |
| <i>Lasiacis divaricata</i>                                   | -                  | 1                  | IV              |
| <i>Selenicereus grandiflorus</i>                             | -                  | 1                  | IV              |
| <i>Rivina humilis</i>  | -                  | 1                  | IV              |
| <i>Oeceoclades maculata</i>                                  | -                  | 1                  | IV              |
| <i>Agave</i> sp.   | -                  | 1                  | IV              |
| <i>Lantana camara</i>  | -                  | 1                  | IV              |
| <i>Urochloa humidicola</i>                                   | -                  | 1                  | IV              |
| Lianas   |                    |                    |                 |
| <i>Pisonia aculeata</i>                                      | -                  | 1                  | V               |
| <i>Smilax havanensis</i>                                     | -                  | 1                  | V               |
| <i>Stigmaphyllon sagreanum</i>                               | -                  | 1                  | V               |
| <i>Gouania lupuloides</i>                                    | -                  | 1                  | V               |
| <i>Serjania diversifolia</i>                                 | -                  | 1                  | V               |
| <i>Chiococca alba</i>  | -                  | 1                  | V               |
| <i>Turbina corymbosa</i>                                     | -                  | 1                  | IV              |
| <i>Tragia hexandra</i>                                       | -                  | 1                  | IV              |
| Epiphytes  |                    |                    |                 |
| <i>Tillandsia fasciculata</i>                                | -                  | 1                  | IV              |

Scattered species in the canopy layer: cedar (*Cedrela odorata*), carbonero, bijáguara (*Colubrina ferruginosa*), guamá (*Lonchocarpus domingensis*), penda, roble (*Tabebuia* sp.), mamoncillo (*Melicoccus bijugatus*), mahogany (*Swietenia mahagoni*), yaití, bone and cúrbana (*Canella alba*).

are given by the degree of successional development and the ecological conditions, mainly exposure and position on the slope. Therefore, as they are located in the same area, they will be studied together, specifying only the differences. The canopy layer is from sparse to slightly sparse (70 to 90%) and reaches between 9 and 12 m tall. Floristically, it is quite heterogeneous; a total of 41 species was found reaching this layer.

**Oecotope characteristics.** The studied site is hills between 20 and 100 m asl. Most of it is located on the north side of the Coastal Terraces south of Sierra Maestra, so their secondary watershed and dells (that only run with considerable rainfall) are preferably north-northwest directed and to a lesser degree, northwest. The most frequent inclination is between 20-40°. The microrelief on the side is generally flat. The mean annual temperature is around 26°C and the average maximum is about 32°C. Annual precipitation is near 800 mm (little rainy) and the mean annual evaporation is between 1700 and 1900 mm (Montenegro, 1991a, b, d). Therefore, it is considered a tropical climate with 4bTh subtype dry winter, with 5 to 6 months with little rain (semidry).

From the geological point of view, these hills are composed by marls from La Cruz formation (Comisión Cubano - Húngara, 1976). Soils are brown (with carbonate), and they are from shallow to very shallow. They even react with saliva. It is usually clay loam, sandy clay or sandy; stony in greater or lesser extent, with small and medium stones. Therefore, in general, the edatope is considered as dry (1) and little fertile (A), and the potential production capacity is inferred as bad (IV). The typology classification is considered A1<sub>x</sub>, 4bTh<sub>b</sub>, IV, S.s., C.w.

Regarding the withered leaves, the L layer reaches about 2 cm. The F layer is generally absent, except for areas with higher earthworm activity and the H is missing. This activity (which is higher in the more advanced successional stages) is very important here, because it incorporates organic matter into the soil. They form a mixed layer of 1 to 1.5 cm of soil and half-decomposed withered leaves, which influences the ecosystem nutrients cycle. Due to this rapid decomposition of fallen leaves and the total absence of root mat, the fermentation process can be considered as quick (Herrera & Rodríguez, 1988).

The three subtypes (successional stages) are:

Cuyá with cúrbana and guatapaná,  
Cuyá with cúrbana and black ebony,  
Cuyá with cúrbana and lirio santana.  
Special features of the subtypes.

### **Cuyá with cúrbana and guatapaná (*Sideroxylon salicifolium* with *Canella winterana* and *Acacia macracantha*; Table 15)**

This type of forest is the least advanced transitional successional stage. Here, frijolillo and guatapaná still play an important role in the canopy layer, which is slightly sparse. The cover of guairaje and cuyá is still very low. In the group of constant species, only guatapaná is within the main species group. Frijolillo, cuyá, cúrbana and almacigo are subdominants. In the shrub layer, whose coverage is from medium to high (30-70%), only guairaje is considered as main species, the others are subdominants. The same happens in the herbaceous layer (it is from low to high, 10-90%).

Usually, in this type of forest, soils have a higher degree of development and may be considered as shallow. They preferentially occupy the bottom of the slope (lower basin) and although they are usually steep (30-45°) are directed towards the north (NE-NW). Therefore, the humidity here is more favorable than in other types of forest in this series (dry with a tendency to fresh).

The differential combination has cabo de hacha (*Trichilia hirta*) as a main species and jocuma and uvita (*Cordia alba*) as subdominants. The rest of the species are found in Table 15.

### **Cuyá with cúrbana and black ebony (*Sideroxylon salicifolium* with *Canella winterana* and *Diospyrus grisebachii*; Table 16)**

It is found in the lower slopes of the entire community, as its inclination only occasionally exceeds 20 degrees. Although the position on the slope is variable, it is most commonly found in the upper part thereof; then, the relative height is usually greater than 20 m. The exposure is to the north (NE-NW). Here, the earthworm activity described above is common. This type of forest is a more advanced successional stage than the above (late secondary community). In the canopy layer, cuyá is the main species and cúrbana, guatapaná, frijolillo, almacigo and lirio santana are the subdominants ones. The main species from the shrub layer is guairaje (*Eugenia axillaris*), with a high cover (50-80%). From the herbaceous layer, cuaba de ingenio (media occasionally high covers, 40-70%) was the main specie. Here, the number of tree seedlings is higher than in the previous type of forest. In the differential combination, the subdominants species from the canopy layer are: black ebony and negracuba. Other subdominant species from the shrub and herbaceous layers and liana *synusia* are shown in Table 16.

Table 15. Cuyá with cúrbana and guatapaná  
(*Sideroxylon salicifolium* with *Canella winterana* and *Acacia macracantha*, 6 plots)

| Species   | Vertical structure | Abundance-Coverage | Presence Degree |
|---|--------------------|--------------------|-----------------|
| Canopy layer  |                    |                    |                 |
| <i>Acacia macracantha</i>                                     | D                  | 2                  | V               |
| <i>Senna atomaria</i>   | D                  | 1                  | V               |
| <i>Sideroxylon salicifolium</i>                               | C                  | 1                  | V               |
| <i>Canella winterana</i>                                      | C                  | 1                  | V               |
| <i>Bursera simaruba</i>                                       | C                  | 1                  | V               |
| <i>Lonchocarpus domingensis</i>                               | I                  | 1                  | III             |
| Shrub layer   |                    |                    |                 |
| <i>Eugenia axillaris</i>                                      | -                  | 2                  | V               |
| <i>Coccothrinax fragans</i>                                   | -                  | 1                  | V               |
| <i>Comocladia dentata</i>                                     | -                  | 1                  | V               |
| <i>Bourreria virgata</i>                                      | -                  | 1                  | V               |
| <i>Randia aculeata</i>  | -                  | 1                  | IV              |
| Herbaceous layer  |                    |                    |                 |
| <i>Scleria lithosperma</i>                                    | -                  | 1                  | V               |
| <i>Lasiacis divaricata</i>                                    | -                  | 1                  | V               |
| <i>Paspalum breve</i>   | -                  | 1                  | V               |
| <i>Zapoteca gracilis</i>                                      | -                  | 1                  | IV              |
| <i>Lantana camara</i>   | -                  | 1                  | III             |
| <i>Trema micrantha</i>  | -                  | 1                  | III             |
| Lianas  |                    |                    |                 |
| <i>Stigmaphyllon sagreanum</i>                                | -                  | 1                  | V               |
| <i>Chiococca alba</i>   | -                  | 1                  | V               |
| <i>Smilax havanensis</i>                                      | -                  | 1                  | IV              |
| <i>Cissampelos pareira</i>                                    | -                  | 1                  | III             |
| Differential combination from cuyá with cúrbana and guatapaná |                    |                    |                 |
| Canopy layer  |                    |                    |                 |
| <i>Trichilia hirta</i>  | D                  | 2                  | V               |
| <i>Sideroxylon foetidissimum</i> subsp. <i>foetidissimum</i>  | C                  | 1                  | V               |
| <i>Cordia alba</i>  | C                  | 1                  | V               |
| Shrub layer   |                    |                    |                 |
| <i>Ehretia tinifolia</i>                                      | -                  | 1                  | V               |
| <i>Turnera ulmifolia</i>                                      | -                  | 1                  | V               |
| Herbaceous layer  |                    |                    |                 |
| <i>Erythroxylum havanense</i>                                 | -                  | 1                  | V               |
| <i>Chrysophyllum oliviforme</i>                               | -                  | 1                  | V               |
| <i>Casearia hirsuta</i>                                       | -                  | 1                  | V               |
| <i>Urochloa humidicola</i>                                    | -                  | 1                  | V               |
| <i>Heliotropium indicum</i>                                   | -                  | 1                  | IV              |
| <i>Commelina erecta</i>                                       | -                  | 1                  | IV              |
| <i>Desmanthus virgatus</i>                                    | -                  | 1                  | IV              |
| Lianas  |                    |                    |                 |
| <i>Gouania lupuloides</i>                                     | -                  | 1                  | V               |
| <i>Serjania diversifolia</i>                                  | -                  | 1                  | V               |
| <i>Salacia nipensis</i>                                       | -                  | 1                  | IV              |
| Epiphytes   |                    |                    |                 |
| <i>Tillandsia recurvata</i>                                   | -                  | 1                  | IV              |

Scattered species in the canopy layer: carbonero, jia blanca (*Adelia ricinella*), guara (*Cupania glabra*), *Citharexylum ternatum*, guaguasi (*Zuelania guidonia*), sigua, black ebony (*Diospyrus grisebachii*), guamá (*Lonchocarpus longipes*) and brasil (*Caesalpinia vesicaria*).



Table 16. Cuyá with cúrbana and black ebony  
(*Sideroxylon salicifolium* with *Canella winterana* and *Diospyrus grisebachii*, 8 plots)

| Species   | Vertical structure | Abundance-Coverage | Presence Degree |
|---|--------------------|--------------------|-----------------|
| Canopy layer  |                    |                    |                 |
| <i>Sideroxylon salicifolium</i>                                 | D                  | 3                  | V               |
| <i>Canella winterana</i>  | C                  | 1                  | V               |
| <i>Acacia macracantha</i>                                       | C                  | 1                  | V               |
| <i>Senna atomaria</i>   | C                  | 1                  | V               |
| <i>Bursera simaruba</i>   | C                  | 1                  | V               |
| <i>Exostema caribaeum</i>                                       | I                  | 1                  | V               |
| <i>Sideroxylon foetidissimum</i> subsp. <i>foetidissimum</i>    | C                  | 1                  | IV              |
| <i>Colubrina elliptica</i>                                      | C                  | 1                  | IV              |
| <i>Bourreria virgata</i>  | I                  | 1                  | IV              |
| Shrub layer   |                    |                    |                 |
| <i>Eugenia axillaris</i>  | -                  | 3                  | V               |
| <i>Comocladia dentata</i>                                       | -                  | 1                  | V               |
| <i>Randia aculeata</i>  | -                  | 1                  | V               |
| <i>Lantana montevidensis</i>                                    | -                  | 1                  | IV              |
| <i>Zanthoxylum fagara</i>                                       | -                  | 1                  | IV              |
| Herbaceous layer  |                    |                    |                 |
| <i>Croton lucidus</i>   | -                  | 2                  | V               |
| <i>Coccothrinax fragans</i>                                     | -                  | 1                  | V               |
| <i>Lasiacis divaricata</i>                                      | -                  | 1                  | IV              |
| <i>Paspalum breve</i>   | -                  | 1                  | IV              |
| <i>Scleria lithosperma</i>                                      | -                  | 2                  | IV              |
| <i>Zapoteca gracilis</i>  | -                  | 1                  | III             |
| <i>Varronia globosa</i> subsp. <i>humilis</i>                   | -                  | 1                  | III             |
| <i>Morinda royoc</i>  | -                  | 1                  | III             |
| <i>Erythroxylum rotundifolium</i>                               | -                  | 1                  | III             |
| Lianas  |                    |                    |                 |
| <i>Tragia hexandra</i>  | -                  | 1                  | V               |
| <i>Chiococca alba</i>   | -                  | 1                  | V               |
| <i>Smilax havanensis</i>  | -                  | 1                  | V               |
| <i>Stigmaphyllon sagreanum</i>                                  | -                  | 1                  | IV              |
| <i>Salacia nipensis</i>   | -                  | 1                  | IV              |
| <i>Passiflora suberosa</i>                                      | -                  | 1                  | IV              |
| <i>Gouania lupuloides</i>                                       | -                  | 1                  | III             |
| <i>Distictis rhynchocarpa</i>                                   | -                  | 1                  | III             |
| <i>Triopteris rigida</i>  | -                  | 1                  | III             |
| Differential combination from cuyá with cúrbana and black ebony |                    |                    |                 |
| Canopy layer  |                    |                    |                 |
| <i>Diospyrus grisebachii</i>                                    | I                  | 1                  | V               |
| <i>Thouinia patentinervis</i>                                   | I                  | 1                  | IV              |
| Shrub layer   |                    |                    |                 |
| <i>Trema micrantha</i>  | -                  | 1                  | IV              |
| <i>Erithalis fruticosa</i>                                      | -                  | 1                  | IV              |
| <i>Lantana camara</i>   | -                  | 1                  | IV              |
| Herbaceous layer  |                    |                    |                 |
| <i>Spermacoce laevis</i>  | -                  | 1                  | IV              |
| <i>Bourreria setoso-hispida</i>                                 | -                  | 1                  | IV              |
| <i>Varronia lineata</i>   | -                  | 1                  | IV              |
| <i>Euphorbia heterophylla</i>                                   | -                  | 1                  | IV              |
| Lianas  |                    |                    |                 |
| <i>Cissus verticillata</i>                                      | -                  | 1                  | IV              |

Scattered species in the canopy layer: cuabilla (*Amyris elemifera*), guaguasi, roble prieto, guamá de costa (*Lonchocarpus longipes*), guamá (*Lonchocarpus domingensis*), guara, sigua, *Citharexylum ternatum*, brasil, jia blanca and raspalengua (*Casearia hirsuta*).

**Cuyá with cúrbana and lirio santana  
(*Sideroxylon salicifolium* with *Canella winterana* and *Exostema caribaeum*; Table 17)**

It is generally observed in exposures to the west (N to SSW), on slopes of 20-40° and generally, in the mid to upper hillside, so the relative height is greater than 20 m. The microrelief is often slightly wavy.

This forest is also a late secondary community; the main tree pioneers (guatapaná and frijolillo) generally have diminished vitality and poor or very poor regeneration. The dominant species in the canopy layer are cuyá and cúrbana and the above mentioned species and the almácigo are also subdominant.

In the shrub layer (high cover, 50-80%) guairaje (*Eugenia axillaris*) is the main specie; while in the herbaceous (media to heig covers, 40-70%) it is cortadera (*Scleria lithosperma*). The other subdominant species in both layers, as well as lianas are shown in Table 17. The proportion of tree seedlings is high in these strata, which also confirmed how advanced the successional stage is.

The soil is very shallow, sometimes gravelly and with some stones on the surface. Due to its inclination, position on the slope and exposure, it can be considered as a dry (I) and little fertile (A) oecotope.

Table 17. Cuyá with cúrbana and lirio santana  
(*Sideroxylon salicifolium* with *Canella winterana* and *Exostema caribaeum*, 6 plots)

| Species   | Vertical structure | Abundance-Coverage | Presence Degree |
|---|--------------------|--------------------|-----------------|
| Canopy layer  |                    |                    |                 |
| <i>Sideroxylon salicifolium</i>                                   | D                  | 2                  | V               |
| <i>Canella winterana</i>  | D                  | 1                  | V               |
| <i>Bursera simaruba</i>   | C                  | 1                  | V               |
| <i>Acacia macracantha</i>   | I                  | 1                  | V               |
| <i>Senna atomaria</i>   | I                  | 1                  | V               |
| Shrub layer   |                    |                    |                 |
| <i>Eugenia axillaris</i>  | -                  | 2                  | V               |
| <i>Randia aculeata</i>  | -                  | 1                  | V               |
| <i>Lantana montevidensis</i>                                      | -                  | 1                  | V               |
| <i>Amyris elemifera</i>   | -                  | 1                  | V               |
| <i>Caesalpinia vesicaria</i>                                      | -                  | 2                  | III             |
| <i>Comocladia dentata</i>   | -                  | 1                  | III             |
| Herbaceous layer  |                    |                    |                 |
| <i>Scleria lithosperma</i>  | -                  | 2                  | V               |
| <i>Coccothrinax fragans</i>                                       | -                  | 1                  | V               |
| <i>Croton lucidus</i>   | -                  | 1                  | V               |
| <i>Zapoteca gracilis</i>  | -                  | 1                  | V               |
| <i>Zanthoxylum fagara</i>   | -                  | 1                  | V               |
| <i>Paspalum breve</i>   | -                  | 1                  | V               |
| <i>Simarouba laevis</i>   | -                  | 1                  | V               |
| <i>Lasiacis divaricata</i>  | -                  | 1                  | IV              |
| <i>Oplonia tetrasticha</i>  | -                  | 1                  | III             |
| Lianas  |                    |                    |                 |
| <i>Tragia hexandra</i>  | -                  | 1                  | V               |
| <i>Stigmaphyllon sagreanum</i>                                    | -                  | 1                  | V               |
| <i>Chiococca alba</i>   | -                  | 1                  | V               |
| <i>Smilax havanensis</i>  | -                  | 1                  | V               |
| <i>Tragia volubilis</i>   | -                  | 1                  | IV              |
| <i>Salacia nipensis</i>   | -                  | 1                  | III             |
| <i>Distictis rhynchocarpa</i>                                     | -                  | 1                  | III             |
| Differential combination from cuyá with cúrbana and lirio santana |                    |                    |                 |
| <i>Exostema caribaeum</i>   | I                  | 1                  | V               |
| <i>Colubrina elliptica</i>  | C                  | 1                  | IV              |
| <i>Passiflora suberosa</i>  | -                  | 1                  | IV              |

Scattered species in the canopy layer: negracuba, raspalengua, black ebony, jocuma, roble prieto, sigua, guara, *Citharexylum ternatum* and cuaba prieta.

Terms for forest management. As these subtypes are successional stages, enrichment with valuable species from the forestry point of view should be achieved in silvicultural treatment, mainly in the less advanced stages. Some of these species are: cedar, bijáguara, roble (*Tabebuia* sp.), mahogany, bone, cuyá, jocuma, brasil, sabicú, dagame and baría.

**Guatapaná with frijolillo and cafecillo (*Acacia macracantha* with *Senna atomaria* and *Bourreria virgata*; Table 18)**

Physiognomy and floristic composition. Low secondary forest showing dominance of thorny legumes. It is an early community (homeostasis I) after total or near total destruction of the previous vegetation. The canopy layer is low and fairly open sparse (50 to 60%); its height is about 7 to 8 m. The main species at the group of constant species are guatapaná and frijolillo; while the subdominant are ipil ipil and uvita. The species from the other strata and synusiaes, including the group of accompanying species and of differential combination are shown in Table 18. The difference with the shrub layer is often unclear.

Oecotope characteristics. It can be seen below 150 m a.s.l, showing a flat microrelief; exposures are varied, mainly to the south. The slope varies between 15-25°. The mean annual temperature ranges from 24-26°C. The mean annual relative humidity is 75 to 80% and evaporation is 1700 to 1900 mm (Montenegro, 1991a, b, c). It rains about 1000 mm, with little rainy season from November to April and a rainy from May to October. It is therefore considered a tropical climate with dry winter, 4bTh subtype, with 5-6 dry months (semi-dry). It is also heavily influenced by the salt spray sea breezes. It occurs on soils derived from volcanogenic sedimentary rocks and limestones. The soil is fersiallitic reddish brown (Renda, 1989), very shallow and highly eroded. Therefore, it is considered as very dry (0) and little fertile (A). The potential production capacity is inferred as very bad (V) and the typology classification is A0, 4bTh<sub>b-c</sub>, V, A.m., S.a., Bv.

Distribution. It was studied in the southern part of Sierra del Turquino, near the community of Las Brujas (Santiago de Cuba Province).

Terms for forest management. As they are an early community (homeostasis I) after the destruction of the original forest, it has very little diversity of tree species in the shrub and herbaceous layers. That is why, an enrichment with species adapted to the oecotope is advised; such as: jatía, baría, carbonero, majaguilla, almácigo, sigua, cuyá, yarúa and macaguey (toad).

**Guatapaná with frijolillo and raspalengua (*Acacia macracantha* with *Senna atomaria* and *Casearia hirsuta*; Table 19)**

Physiognomy and floristic composition. This forest type is an early community (homeostasis I), i.e. the relative equilibrium stage taking place after the first phase fieria (Reyes & al., 2004b). The canopy layer reaches between 6 and 9 m and is slightly sparse (80-90%). The main species are guatapaná and frijolillo, especially the first which determine the physiognomy of the ecosystem. They form a continuous and clear canopy that allows the passage of light. Uvita is the subdominant species. The shrub (20-60%) and herbaceous (30-70%) layers have a covers from medium to high, exceptionally less. They are mainly composed by woody micro and nanophanerophytes, some herbaceous and lianas, which can be found in Table 19.

Since guatapaná is the main contributor to the withered leaves, and it has leptophyll leaflets, the L layer is generally less than a centimeter and often scattered. The F layer is barely noticeable and the H only contains (sometimes) remains on the ground. For this and the absence of root mat, fermentation can be considered quick (Herrera & Rodriguez, 1988).

Oecotope characteristics. The studied areas are hills between 20 and 100 m asl Their secondary watershed and dells (which only run with considerable rainfall) are preferably north-west directed and to a lesser degree, northwest. The most frequent inclination is between 20 and 40 degrees, the microrelief on the side is generally flat. It prefers sunny exposures, especially to the southwest. The relative height is less than 20 m in general. The mean annual temperature is around 26°C and the mean maximum is about 32°C. The annual precipitation is near 800 mm (little rain) and the mean annual evaporation is between 1700 and 1900 mm (Montenegro, 1991a, b, c); so it can be considered a tropical climate with two dry periods, 5aTh subtype, extremely dry tropical bixeric.

Geologically, these hills are composed by Pliocene marl from La Cruz formation. Soils are brown (carbonate), from shallow to very shallow and even react with saliva. They are commonly sandy loam and sometimes locally gravelly. It is often rocky with small and mid-stones on the top of the profile. The laminar erosion is variable; in some places it is weak, in other is strong though. Regarding the edatope moisture, it can be considered as dry (1) and little fertile (A). The typology classification is as follows A<sub>x</sub>1, 5aTh<sub>b</sub>, IV, A.m., S.a., C.h.

Table 18. Characteristic combination of guatapaná with frijolillo and cafecillo  
(*Acacia macracantha* with *Senna atomaria* and *Bourreria virgata*, 4 plots)

| Species   | Vertical structure | Abundance-Coverage | Presence Degree |
|---|--------------------|--------------------|-----------------|
| Canopy layer  |                    |                    |                 |
| <i>Acacia macracantha</i>   | D                  | 3                  | V               |
| <i>Senna atomaria</i>   | D                  | 2                  | V               |
| <i>Cordia alba</i>  | C                  | 1                  | V               |
| Herbaceous layer  |                    |                    |                 |
| <i>Bothriochloa pertusa</i>   | -                  | 2                  | V               |
| <i>Zapoteca gracilis</i>  | -                  | 1                  | V               |
| <i>Commelina diffusa</i>  | -                  | 1                  | V               |
| <i>Spermacoce laevis</i>  | -                  | 1                  | V               |
| <i>Malpighia cnide</i>  | -                  | 1                  | IV              |
| <i>Sida rhombifolia</i>   | -                  | 1                  | IV              |
| <i>Malvastrum corchorifolium</i>                                      | -                  | 1                  | III             |
| <i>Urochloa humidicola</i>  | -                  | 1                  | III             |
| <i>Helicteres</i> sp.   | -                  | 1                  | III             |
| <i>Coccothrinax fragans</i>   | -                  | 1                  | III             |
| <i>Desmanthus virgatus</i>  | -                  | 1                  | III             |
| <i>Zanthoxylum fagara</i>   | -                  | 1                  | III             |
| <i>Corchorus</i> sp.  | -                  | 1                  | III             |
| <i>Bourreria</i> sp.  | -                  | 1                  | III             |
| <i>Wissadula periplocifolia</i>                                       | -                  | 1                  | III             |
| <i>Sida acuta</i>   | -                  | 1                  | III             |
| <i>Desmodium</i> sp.  | -                  | 1                  | III             |
| Lianas  |                    |                    |                 |
| <i>Stigmaphyllon sagreanum</i>  | -                  | 1                  | V               |
| <i>Dalechampia scandens</i>   | -                  | 1                  | V               |
| <i>Cissus trifoliata</i>  | -                  | 1                  | V               |
| <i>Chiococca alba</i>   | -                  | 1                  | IV              |
| <i>Tournefortia volubilis</i>   | -                  | 1                  | IV              |
| <i>Triopteris rigida</i>  | -                  | 1                  | IV              |
| <i>Centrosema virginianum</i>   | -                  | 1                  | III             |
| <i>Commicarpus scandens</i>   | -                  | 1                  | III             |
| <i>Galactia</i> sp.   | -                  | 1                  | III             |
| <i>Ipomoea</i> sp.  | -                  | 1                  | III             |
| Epiphytes   |                    |                    |                 |
| <i>Tillandsia recurvata</i>   | -                  | 1                  | IV              |
| Differential combination from guatapaná with frijolillo and cafecillo |                    |                    |                 |
| <i>Bourreria virgata</i>  | I                  | 2                  | V               |
| <i>Leucaena leucocephala</i>  | C                  | 1                  | V               |
| <i>Varronia globosa</i> subsp. <i>humilis</i>                         | -                  | 3                  | V               |
| <i>Wissadula amplissima</i>   | -                  | 1                  | V               |
| <i>Lantana reticulata</i>   | -                  | 1                  | V               |
| <i>Phyllostylon brasiliensis</i>                                      | -                  | 1                  | IV              |
| <i>Adelia ricinella</i>   | -                  | 1                  | IV              |
| <i>Randia aculeata</i>  | -                  | 1                  | IV              |

Scattered species in the canopy layer: *Casearia* sp., *cuaba prieta*.

Table 19. Guatapaná with frijolillo and raspalengua (*Acacia macracantha* with *Senna atomaria* and *Casearia hirsuta*) in the marls from the South Coastal Terraces of Sierra Maestra (6 plots).

| Species   | Vertical structure | Abundance-Coverage | Presence Degree |
|---|--------------------|--------------------|-----------------|
| Canopy layer  |                    |                    |                 |
| <i>Acacia macracantha</i>   | D                  | 4                  | V               |
| <i>Senna atomaria</i>   | D                  | 2                  | V               |
| <i>Cordia alba</i>  | C                  | 1                  | V               |
| <i>Ehretia tinifolia</i>  | C                  | 1                  | IV              |
| Shrub layer   |                    |                    |                 |
| <i>Coccothrinax fragans</i>   | -                  | 1                  | IV              |
| <i>Lantana camara</i>   | -                  | 1                  | IV              |
| Herbaceous layer  |                    |                    |                 |
| <i>Waltheria indica</i>   | -                  | 1                  | V               |
| <i>Zapoteca gracilis</i>  | -                  | 1                  | V               |
| <i>Lantana montevidensis</i>  | -                  | 1                  | V               |
| <i>Wissadula periplocifolia</i>   | -                  | 1                  | V               |
| <i>Melochia nodiflora</i>   | -                  | 1                  | V               |
| <i>Euphorbia heterophylla</i>   | -                  | 1                  | V               |
| <i>Spermacoce laevis</i>  | -                  | 1                  | V               |
| <i>Bothriochloa pertusa</i>   | -                  | 1                  | V               |
| <i>Urochloa humidicola</i>  | -                  | 1                  | V               |
| <i>Scleria lithosperma</i>  | -                  | 1                  | V               |
| <i>Lasiacis divaricata</i>  | -                  | 1                  | V               |
| <i>Dicliptera vahliana</i>  | -                  | 1                  | IV              |
| <i>Jatropha gossipifolia</i>  | -                  | 1                  | IV              |
| <i>Cenchrus ciliaris</i>  | -                  | 2                  | IV              |
| <i>Commelina erecta</i>   | -                  | 1                  | IV              |
| <i>Varronia globosa</i> subsp. <i>humilis</i>                           | -                  | 1                  | III             |
| <i>Erythroxylum havanense</i>   | -                  | 1                  | III             |
| <i>Hibiscus brasiliensis</i>  | -                  | 1                  | III             |
| <i>Comocladia dentata</i>   | -                  | 1                  | III             |
| <i>Chromolaena odorata</i>  | -                  | 1                  | III             |
| <i>Pavonia spinifex</i>   | -                  | 1                  | III             |
| Lianas  |                    |                    |                 |
| <i>Passiflora suberosa</i>  | -                  | 1                  | V               |
| <i>Stigmaphyllon sagreanum</i>  | -                  | 1                  | V               |
| <i>Tournefortia volubilis</i>   | -                  | 1                  | V               |
| <i>Centrosema virginianum</i>   | -                  | 1                  | V               |
| <i>Desmanthus virgatus</i>  | -                  | 1                  | V               |
| <i>Smilax havanensis</i>  | -                  | 1                  | V               |
| <i>Triopteris rigida</i>  | -                  | 1                  | V               |
| <i>Passiflora foetida</i>   | -                  | 1                  | IV              |
| <i>Salacia nipensis</i>   | -                  | 1                  | IV              |
| <i>Merrenia bisecta</i>   | -                  | 1                  | III             |
| <i>Chiococca alba</i>   | -                  | 1                  | III             |
| <i>Serjania diversifolia</i>  | -                  | 1                  | III             |
| Epiphytes   |                    |                    |                 |
| <i>Tillandsia recurvata</i>   | -                  | 1                  | IV              |
| <i>Tillandsia fasciculata</i>   | -                  | 1                  | III             |
| Differential combination from guatapaná with frijolillo and raspalengua |                    |                    |                 |
| <i>Casearia hirsuta</i>   | -                  | 1                  | V               |
| <i>Turnera ulmifolia</i>  | -                  | 1                  | V               |
| <i>Paspalum breve</i>   | -                  | 1                  | V               |
| <i>Echites umbellata</i>  | -                  | 1                  | V               |
| <i>Plumbago scandens</i>  | -                  | 1                  | V               |

Scattered species in the canopy layer: cuyá, jubaban (*Trichilia hirta*), brasil, cúrbana, jía blanca, jocuma, penda, aguedita dulce, carbonero, agalla de costa and cafecillo.

Distribution. It presents its greatest extent in the northeastern part of the marly hills from the South Coastal Terraces of Sierra Maestra.

Terms for forest management. As it is a community similar to the previous forest (homeostasis I), it has very little diversity of tree species in the shrub and herbaceous layers. That is why, enrichment with species adapted to the oecotope is advised; such as: jatía, baría, carbonero, majaguilla, almácigo, sigua, cuyá, yarúa and macaguey (toad).

### **Yaya with almácigo (*Oxandra lanceolata* with *Bursera simaruba*; Table 20)**

Physiognomy and floristic composition. Although this vegetation type (semideciduous mesophyll forest) has been exploited for livestock development, the analyzed area has a high degree of naturalness. The canopy layer has coverage from sparse to slightly sparse (50-90%) and a height between 7 and 15 m. In the group of constant species, almácigo and yaya (*Oxandra lanceolata*) are the main species; while baría and guamá candelón (*Piscidia piscipula*) are the subdominant. These species from the shrub and herbaceous layers, as well as the synusiaes of lianas and epiphytes are found in Table 20.

In the group of accompanying species, jocuma, guámano (*Cupania americana*), guásima, jobo (*Spondias mombin*), jatía and sabicú (*Lysiloma sabicu*) are subdominant species. Bone, yaití, guara, guaguasí, tongue (*Poeppigia procera*), royal palm (*Roystonea regia*), ramon horse (*Trophis racemosa*), cuyá and majaguilla are aggregated species. Plants from other layer are shown in Table 20.

The species from the shrub layer with a cover from medium to high (40-90%) and the herbaceous layer with medium (30-50%) are found in Table 20. The composition of biological types is as follows: 40.5% of the species are trees, 24.3% are shrubs, 13.5% form the herbaceous layer, 2.7% are ferns, 16.2% are lianas and the 4.1%, epiphytes.

Oecotope characteristics. The microrelief is generally flat. It locally shows rocky outcrops on the surface. The slope is also very variable, ranging between 20 and 40 degrees. The exposure has two main trends: one to the east and the other to south. The altitude varies between 120 and 200 m asl. The mean annual rainfall in this area is 1000 to 1200 mm per year, i.e. moderately rainy. There are two distinct periods: the dry season, from November to April (between 300 and 400 mm) and the rainy season, from May to October (800 and 1000 mm) (Montenegro, 1991a). It is consi-

dered a tropical climate with dry winter, sub-type 4bTh, with 5-6 dry months (semi-dry).

The most important soil is the reddish brown fersiallitic; its depth varies from very shallow to moderately deep. It drains well, both internal and external. Therefore, the edatope is considered as dry (1) and from little to moderately fertile (B). Withered leaves are unevenly distributed, the L layer ranges between 1.5 and 3 cm, occasionally more; in isolated nanodepressions can reach up to 15 cm. F and H layers are almost imperceptible, and only the last is observed, mixed with the horizon A. In turn, the potential productive capacity is considered from bad (IV) to regular (III). The typology classification is as follows B1, 4bTh<sub>c</sub>, III-IV, O.l., B.s.

Distribution. This forest is a typical semideciduous mesophyll forest, which had a large area in the flat and premountain areas. It was studied on the southern slope of the mountain range of Sierra Maestra. Nowadays, the most extensive relict is located near the mouth of Turquino river.

Terms for forest management. Almost all areas from the mesophyll semideciduous forest have been destroyed for agriculture and livestock purposes, so it is necessary to preserve these relics, which are relatively rich in tree species.

### **Jubaban with guásima (*Trichilia hirta* with *Guazuma ulmifolia*; Table 21)**

Physiognomy and floristic composition. This secondary forest is a late secondary community (fiera II and homeostasis II) from the successional series that takes place in the mesophyll semideciduous forest; the most advanced one has more species in all strata. The canopy layer is irregular in height and varies from 7 to 12 m. Cover is from sparse to dense (60-100%). Among the group of constant species, guásima (the most abundant) and frijolillo are the main species. The subdominants are jubaban, baría, jobo, majaguilla, negracuba and yuraguana (*Coccothrinax gundlachii*). In the group of accompanying species, almácigo is subdominant and aguedita (*Celtis trinervia*) aggregated. The species in the shrub layer with a covers from medium to high (40-80%) are in Table 21, as well as the species with medium coverage (30-50%) from the herbaceous layer and lianas.

Oecotope characteristics. It occurs between 40 and 100 m asl, with an inclination of 20-37° and in various exposures. The microrelief is relatively flat. The mean annual temperature ranges from 24 to

Table 20. Yaya with almácigo  
(*Oxandra lanceolata* with *Bursera simaruba*, 9 plots)

| Species  | Vertical structure | Abundance-Coverage | Presence Degree |
|--|--------------------|--------------------|-----------------|
| Canopy layer   |                    |                    |                 |
| <i>Bursera simaruba</i>                                      | D                  | 2                  | V               |
| <i>Oxandra lanceolata</i>                                    | D                  | 2                  | V               |
| <i>Cordia gerascanthus</i>                                   | C                  | 1                  | V               |
| <i>Piscidia piscipula</i>                                    | C                  | 1                  | V               |
| <i>Sideroxylon foetidissimum</i> subsp. <i>foetidissimum</i> | C                  | 1                  | IV              |
| <i>Cupania americana</i>                                     | C                  | 1                  | IV              |
| <i>Guazuma ulmifolia</i>                                     | C                  | 1                  | IV              |
| <i>Spondias mombin</i>                                       | C                  | 1                  | IV              |
| <i>Phyllostylon brasiliensis</i>                             | I                  | 1                  | IV              |
| <i>Lysyloma sabicu</i>                                       | I                  | 1                  | IV              |
| <i>Drypetes alba</i>   | C                  | 1                  | III             |
| <i>Gymnanthes lucida</i>                                     | I                  | 1                  | III             |
| <i>Cupania glabra</i> var. <i>glabra</i>                     | C                  | 1                  | III             |
| <i>Zuelania guidonia</i>                                     | C                  | 1                  | III             |
| <i>Roystonea regia</i>                                       | C                  | 1                  | III             |
| <i>Trophis racemosa</i>                                      | C                  | 1                  | III             |
| <i>Sideroxylon salicifolium</i>                              | C                  | 1                  | III             |
| <i>Poeppigia procera</i>                                     | I                  | 1                  | III             |
| <i>Carpodiptera cubensis</i>                                 | I                  | 1                  | III             |
| Shrub layer  |                    |                    |                 |
| <i>Erythroxylum havanense</i>                                | -                  | 1                  | V               |
| <i>Picramnia pentandra</i>                                   | -                  | 1                  | V               |
| <i>Coccothrinax gundlachii</i>                               | -                  | 1                  | IV              |
| <i>Trichilia hirta</i>                                       | -                  | 1                  | IV              |
| <i>Capparis flexuosa</i>                                     | -                  | 1                  | III             |
| <i>Casearia sylvestris</i> var. <i>myricoides</i>            | -                  | 1                  | III             |
| Herbaceous layer   |                    |                    |                 |
| <i>Olyra latifolia</i>                                       | -                  | 1                  | V               |
| <i>Oeceoclades maculata</i>                                  | -                  | 1                  | IV              |
| <i>Urochloa humidicola</i>                                   | -                  | 1                  | III             |
| <i>Zapoteca gracilis</i>                                     | -                  | 1                  | III             |
| <i>Rivina humilis</i>  | -                  | 1                  | III             |
| Lianas   |                    |                    |                 |
| <i>Serjania diversifolia</i>                                 | -                  | 1                  | V               |
| <i>Gouania lupuloides</i> var. <i>lupuloides</i>             | -                  | 1                  | V               |
| <i>Pisonia aculeata</i>                                      | -                  | 1                  | V               |
| <i>Stigmaphyllon sagreanum</i>                               | -                  | 1                  | V               |
| Epiphytes  |                    |                    |                 |
| <i>Tillandsia recurvata</i>                                  | -                  | 1                  | V               |

Scattered species in the canopy layer: yaicuaje (*Exothea paniculata*), yaba (*Geoffroea inermis*), dagame (*Calycophyllum candidissimum*), carbonero (*Collubrina reclinata*), almendrillo (*Prunus myrtifolia*), jaguey macho (*Ficus membranacea*), ayua (*Zanthoxylum martinicensis*), roble blanco (*Tabebuia angustata*) and ceiba (*Ceiba pentandra*).

Localities: Southern slope of Sierra Maestra.

26 °C, with a mean annual high of 30-32°C and a mean annual low of 22-24°C. The mean annual relative humidity is 75-80%. Evaporation is 1700-1900 mm (Montenegro, 1991a, b, c, d). It rains about 1000 mm

(slightly rainy limit), with a little rainy period from november to april and a rainy, from may to october. It is considered a tropical climate with dry winter, 4bTh subtype, with 5-6 dry months (semi-dry).

The soil is reddish brown fersiallitic, very shallow, gravelly, with a percentage of stones from 50-80%, exceptionally lower. This forest type occupies the middle and lower zones of the microbasin, so their water situation is relatively more favorable than in the upper basins. Due to the large slope, withered leaves are very sparse where it accumulates. Sometimes among the stones, an L layer (1-2cm) and a generally imperceptible F are observed. Sometimes such layers are mixed.

Therefore, it is considered as a dry (1) and little fertile (A) edatope, so its potential productive capacity is considered bad (IV). The typology classification is as follows  $A_{xx-xxx}^1$ ,  $4bTh_{b-c}$ , IV, T.h., G.u.

Distribution. It was studied at the bottom of the southern slope of Sierra del Turquino.

Terms for forest management. This forest can be enriched with cedar, mahogany, baria, yarúa and ayúa.

Table 21. Characteristic combination of jubabán with guásima (*Trichilia hirta* with *Guazuma ulmifolia*, 6 plots)

| Species  | Vertical structure | Abundance-Coverage | Presence Degree |
|--|--------------------|--------------------|-----------------|
| Canopy layer                                     |                    |                    |                 |
| <i>Guazuma ulmifolia</i>                         | D                  | 4                  | V               |
| <i>Senna atomaria</i>                            | I                  | 2                  | V               |
| <i>Trichilia hirta</i>                           | D                  | 1                  | V               |
| <i>Spondias mombin</i>                           | C                  | 1                  | V               |
| <i>Cordia gerascanthus</i>                       | C                  | 1                  | V               |
| <i>Carpodiptera cubensis</i>                     | I                  | 1                  | V               |
| <i>Thouinia patentinervis</i>                    | I                  | 1                  | V               |
| <i>Coccothrinax gundlachii</i>                   | I                  | 1                  | V               |
| <i>Bursera simaruba</i>                          | C                  | 1                  | IV              |
| <i>Celtis trinervia</i>                          | I                  | 1                  | III             |
| Shrub layer                                      |                    |                    |                 |
| <i>Varronia globosa</i> subsp. <i>humilis</i>    | -                  | 2                  | V               |
| <i>Phyllostylon brasiliensis</i>                 | -                  | 1                  | V               |
| <i>Erythroxylum havanense</i>                    | -                  | 1                  | V               |
| Herbaceous layer                                 |                    |                    |                 |
| <i>Melochia nodiflora</i>                        | -                  | 1                  | V               |
| <i>Lantana montevidensis</i>                     | -                  | 1                  | V               |
| <i>Desmodium incanum</i>                         | -                  | 1                  | V               |
| <i>Commelina elegans</i>                         | -                  | 1                  | V               |
| <i>Wissadula amplissima</i>                      | -                  | 1                  | V               |
| <i>Bothriochloa pertusa</i>                      | -                  | 1                  | V               |
| <i>Urochloa humidicola</i>                       | -                  | 1                  | IV              |
| <i>Pavonia fruticosa</i>                         | -                  | 1                  | IV              |
| <i>Abutilon</i> sp.                              | -                  | 1                  | IV              |
| <i>Eupatorium</i> sp.                            | -                  | 1                  | III             |
| <i>Harrisia eriophora</i>                        | -                  | 1                  | III             |
| <i>Malpighia suberosa</i>                        | -                  | 1                  | III             |
| <i>Picramnia pentandra</i>                       | -                  | 1                  | III             |
| <i>Bidens pilosa</i>                             | -                  | 1                  | III             |
| Lianas   |                    |                    |                 |
| <i>Centrosema virginianum</i>                    | -                  | 1                  | V               |
| <i>Gouania lupuloides</i> var. <i>lupuloides</i> | -                  | 1                  | V               |
| <i>Stigmaphyllon sagreanum</i>                   | -                  | 1                  | V               |
| <i>Serjania diversifolia</i>                     | -                  | 1                  | IV              |
| <i>Plumbago scandens</i>                         | -                  | 1                  | IV              |
| <i>Passiflora suberosa</i>                       | -                  | 1                  | III             |
| Epiphytes  |                    |                    |                 |
| <i>Tillandsia recurvata</i>                      | -                  | 1                  | V               |

Scattered species in the canopy layer: cuabilla, yarúa, bayúa (*Zanthoxylum elephantiasis*), yaba and lirio santana. Localities: Southern slope of Sierra del Turquino.



Table 22. Characteristic combination of guámano with guásima  
(*Cupania americana* with *Guazuma ulmifolia*, 4 plots)

| Species  | Vertical structure | Abundance-Coverage | Presence Degree |
|--|--------------------|--------------------|-----------------|
| Canopy layer   |                    |                    |                 |
| <i>Guazuma ulmifolia</i>                                     | D                  | 2                  | V               |
| <i>Cupania americana</i>                                     | D                  | 2                  | V               |
| <i>Cordia gerascanthus</i>                                   | C                  | 1                  | V               |
| <i>Poeppigia procera</i>                                     | C                  | 1                  | V               |
| <i>Trichilia hirta</i>                                       | C                  | 1                  | V               |
| <i>Zanthoxylum martinicense</i>                              | C                  | 1                  | V               |
| <i>Roystonea regia</i>                                       | C                  | 1                  | V               |
| <i>Senna atomaria</i>  | I                  | 2                  | IV              |
| <i>Cupania glabra</i>  | C                  | 1                  | IV              |
| <i>Samanea saman</i>   | C                  | 1                  | IV              |
| <i>Cecropia peltata</i>                                      | C                  | 1                  | IV              |
| <i>Cedrela odorata</i>                                       | C                  | 1                  | IV              |
| <i>Guarea guidonia</i>                                       | C                  | 1                  | IV              |
| <i>Piscidia piscipula</i>                                    | I                  | 1                  | III             |
| Shrub layer  |                    |                    |                 |
| <i>Casearia sylvestris</i> var. <i>sylvestris</i>            | -                  | 1                  | V               |
| <i>Picramnia pentandra</i>                                   | -                  | 1                  | V               |
| <i>Eugenia floribunda</i>                                    | -                  | 1                  | IV              |
| <i>Erythroxylum havanense</i>                                | -                  | 1                  | IV              |
| <i>Casearia hirsuta</i>                                      | -                  | 1                  | IV              |
| <i>Sideroxylon foetidissimum</i> subsp. <i>foetidissimum</i> | -                  | 1                  | IV              |
| <i>Chrysophyllum oliviforme</i>                              | -                  | 1                  | IV              |
| <i>Cordia collococca</i>                                     | -                  | 1                  | III             |
| <i>Psidium guajava</i>                                       | -                  | 1                  | III             |
| <i>Oxandra lanceolata</i> .                                  | -                  | 1                  | III             |
| Herbaceous layer   |                    |                    |                 |
| <i>Desmodium incanum</i>                                     | -                  | 1                  | V               |
| <i>Urochloa humidicola</i>                                   | -                  | 1                  | V               |
| <i>Lasiacis divaricata</i>                                   | -                  | 1                  | V               |
| <i>Adiantum trapeziforme</i>                                 | -                  | 1                  | V               |
| <i>Pavonia fruticosa</i>                                     | -                  | 1                  | IV              |
| <i>Spermacoce assurgens</i>                                  | -                  | 1                  | IV              |
| <i>Pharus glaber</i>   | -                  | 1                  | IV              |
| <i>Randia aculeata</i>                                       | -                  | 1                  | III             |
| <i>Chromolaena odorata</i>                                   | -                  | 1                  | III             |
| <i>Oplismenus setarius</i>                                   | -                  | 1                  | III             |
| <i>Sida rhombifolia</i>                                      | -                  | 1                  | III             |
| <i>Capsicum frutescens</i>                                   | -                  | 1                  | III             |
| <i>Petiveria alliacea</i>                                    | -                  | 1                  | III             |
| <i>Campiloneurum phyllitidis</i>                             | -                  | 1                  | III             |
| Lianas   |                    |                    |                 |
| <i>Gouania lupuloides</i>                                    | -                  | 1                  | V               |
| <i>Ipomoea alba</i>  | -                  | 1                  | V               |
| <i>Pithecoctenium echinatum</i>                              | -                  | 1                  | V               |
| <i>Passiflora suberosa</i>                                   | -                  | 1                  | IV              |
| <i>Serjania diversifolia</i>                                 | -                  | 1                  | IV              |
| <i>Tournefortia hirsutissima</i>                             | -                  | 1                  | IV              |
| <i>Pisonia aculeata</i>                                      | -                  | 1                  | IV              |
| <i>Salacia nipensis</i>                                      | -                  | 1                  | III             |
| <i>Trichostigma octandrum</i>                                | -                  | 1                  | III             |
| <i>Cissampelos pareira</i>                                   | -                  | 1                  | III             |
| <i>Cissus verticillata</i>                                   | -                  | 1                  | III             |
| <i>Aristolochia lindeniana</i>                               | -                  | 1                  | III             |
| <i>Plumbago scandens</i>                                     | -                  | 1                  | III             |
| <i>Hippocratea volubilis</i>                                 | -                  | 1                  | III             |

Scattered species in the canopy layer: bijáguara, penda, jagua (*Genipa americana*), jatía, mije (*Eugenia asperifolia*), majaguilla, yaití, jobo, fustete (*Clorophora tinctoria*), yaba, anacahuita (*Sterculia apetala*), dagame, bien vestido (*Glicicidia sepium*), roble prieto, guatapaná, almácigo, guasimilla del pinar (*Casearia arborea*), yagruma hembra (*Schefflera morototoni*), jaguey macho (*Ficus membranacea*), dairy (*Sapium jamaicense*) and guaguasí.

Localities: Sierra Maestra.

### **Guárano with guásima (*Cupania americana* with *Guazuma ulmifolia*; Table 22)**

Physiognomy and floristic composition. This secondary forest grows in the oecotopes from the semideciduous mesophyll forest and forms the late communities (fiera II and homeostasis II) under these conditions. The canopy layer varies according to the stage of development. In places where it is lower, it is between 7 and 8 m, while in the more syngenetically evolved places it reaches from 12 to 15 m. Cover is slightly sparse (usually 90%), occasionally less. In the group of constant species, the main species are guásima and guárano (*Cupania americana*), while baría, tengue, jubabán, ayúa and royal palm are subdominants. In the group of accompanying species, frijolillo, algarrobo (*Samanea saman*), guárano hembra, yagruma (*Cecropia peltata*), cedar and yamagua (*Guarea guidonia*) are subdominants, while guamá candelon (*Piscidia piscipula*) is aggregated. The species from the shrub (media to high covers, 20-80%) and herbaceous (media, 20-50%) layers, as well as lianas and epiphytes are found in Table 22.

Oecotope characteristics. It takes place at an altitude between 200 and 625 m asl, on slopes of 20 to 40 degrees and in various exposures. It locates in low and premountain areas from Sierra Maestra. Rainfall is seasonal, between 900 and 1200 mm, i.e., moderately rainy. The climate is tropical with dry winter, 4cTh subtype, 3 to 4 months with little rain (moderately dry). Soils vary from fersiallitic and brown to ferrallitic, and from shallow to moderately deep, sometimes with stones on the surface. Humus is underdeveloped. The L layer is between 1 and 3 cm. The F layer usually presents from vestiges to 0.3 cm, only in structurally complex areas can reach 2 cm (with rootlets). H layer is not common; exceptionally, in the above described sites can be, in dispersed form, up to 0.3 cm. Therefore, the edatope is moderately fertile (B), from dry to fresh (1-2), and the potential productive capacity is considered as regular (III). The typology classification is  $B_x 1-2, 4cTh_{b-c}, III, C.a., G.u.$

Distribution. This type of forest is the average conditions of semideciduous mesophyll forest in the Sierra Maestra.

Terms for forest management. It is rich in species, 44 tree species are observed. Then, its treatment is to keep it as such, so that it can develop its full potential. Corresponding oecotopes to such type of forest can be restored with species such as cedar, mahogany, yarúa, baría, ayúa, jocuma, bijáguara and dagame, forming a mixed forest.

### **Amoroso with guásima (*Zanthoxylum fagara* with *Guazuma ulmifolia*; Table 23)**

Physiognomy and floristic composition. This secondary forest successive stage known as fiero II. The canopy layer increases in size with the development of the forest, from 6-8 m to 10-12 m and is considered dense (100%); in the lower parts, no real difference is observed between the canopy and the shrub layers. In the group of constants species guásima and frijolillo are dominant while guarano, guara, amoroso (*Zanthoxylum fagara*), guatapaná, algarrobo, raspalengua and cimitillo (*Chrysophyllum oliviforme*) are subdominants. In turn, in the group of accompanying species are subdominants: jatia, ipil ipil, mije (*Eugenia floribunda*), aguedita (*Picramnia pentandra*), guamá hediondo (*Lonchocarpus blainii*), aguedita sweet, guayaba (*Psidium guajava*) and jubabán. The composition of the other layers and sinusias are found in Table 23.

Oecotope characteristics. The micro relief is irregular and occupies preferably the middle and lower basins. The study was run at an altitude of 220 to 240 m asl, with a 15 to 39 degree slope and changing exposure. The climate is tropical with dry winter, 4bTh subtype, with 5 to 6 months of little rain (medium-dry). The average rainfall ranges from 1000 to 1200 mm and the average temperature is around 25°C.

It lies on rocks of the undifferentiated the Cobre Group. Soils are yellowish brown, shallow, with noticeable sheet erosion and about 5% of rock at the surface. The withered leaves are often scattered, in the less structurally evolved parts L and F layers are mixed and are no thicker than a centimetre; on the contrary, at the more developed layers the L is about 1.5 cm and F 0.5 cm, H is missing. The edatope is considered dry (I) and moderately fertile (B); therefore the potential production capacity is considered bad (IV). The typology classification is as follows  $B1, 4bTh_c, IV, Z.f., G.u.$

Distribution. The study was run at the surroundings of the town El Cobre (Santiago de Cuba province).

Conditions of forest management. As advanced successive stage, it can be enriched with species of forest value such as cedar, mahogany, yarua, baria, jocuma, bijáguara and dagame, among others.

### **Sigua with guara (*Ocotea coriacea* with *Cupania glabra*; Table 24)**

Physiognomy and floristic composition. The canopy layer varies between 7 and 15 m

height and its cover is sparse, occasionally dense (50-100%). In the group of constant species it is only so the sigua, while the guara, jaguey (*Ficus laevigata*), macaguey (toad), yellow lily and aguedita (*Picramnia pentandra*) are subdominants; as for the group of accompanying species, this category is present with ramon cow (*Dendropanax arboreus*), bone, aguedita (*Celtis trinervia*), cuabilla, moruro rojo, raspalengua and guairaje (*Eugenia asperifolia*). As aggregated species, there are: abey (*Abarema glauca*), ayua de sierra, baría and penda. The species in the shrub layer, low sometimes high (10-90%), herbaceous (medium to high, 30-95%) and the sinucias of lianas and epiphytes are found in Table 24.

Oecotope characteristics. The altitude varies from 480 to 645 m asl. The slope is irregular, as it is the exposure. The mean annual temperature is 20 to 22°C (Montenegro, 1991a). In the central area of the studied territory mean annual rainfall is 1634 mm, varying in the analyzed years between 1216 and 2320 mm. There are 94 rainy days (average), ranging between 76 and 111. Evaporation ranges from 1300-1500 mm and relative humidity between 80 and 85% (Montenegro, 1991c, d). Accordingly there is a tropical weather with dry winter, 4cTh subtype, with 3-4 dry months (moderately dry).

This forest grows on limestone and marble. It is present in both the top and bottom of the mogotes in areas of reddish brown soil, or in dog tooth with cavities and diaclasses with red soils, both very shallow. Generally, in this ecosystem, soil is highly involved in the recycling of nutrients. However, it occurs in less extreme conditions that macaguey (toad) with curujey and chicharrón, occupying the same territory. So it is considered a little fertile (A<sub>xxx</sub>) and dry trophism (1). The withered leaves well developed, with an L layer between 1.5 and 5 cm; F is 0.2 to 3 cm, and an H sometimes converted into root mat 0.5 to 2.5 cm, of roots and rootlets embedded in a matrix of humus. In places with more soil, this root mat is smaller, with little humus; in this case there are more rootlets in the first soil horizon. Consistent with the difficult conditions in which this forest develops the potential productive capacity is considered bad (IV). The typology classification is as follows A<sub>xxx</sub> 1, 4cTh<sub>d</sub>, IV, Rm\*, O.c., C.g.

Distribution. This type of forest is located in the geographical area known as Carso de Baire (Núñez & Viña, 1989; Viña Bayés, 1991). It is present in Las Manuelas and La Pimienta.

Conditions of forest management. Due to the conditions under which this type of forest

grows, managing only allows long-term selective extractions (30 or older) to avoid decreasing rates of valuable species from the forestry point of view.

### **Yamagua with ramon cow (*Guarea guidonia* with *Dendropanax arboreus*; Table 25)**

Physiognomy and floristic composition. This type of forest, relatively rich in tree species with 58, is a late secondary community (fiera II), resulting from the neglect of coffee plantations and / or alteration of the forest. It occupies scattered areas, because the corresponding sites are currently in use by agricultural ecosystems. However, it is considered that the full-grown community will have a floristic composition pretty similar to the current one.

The canopy layer is dense (90-100%) and irregular in height, between 8 and 20 m. In the group of constant species there are main ramon cow and yamagua whereas, the subdominant are: ayúa, baría, sigua, yagruma and royal palm. In the group of accompanying species guásima is subdominant and aggregate are: red cedar (*Cedrela cubensis*), jobo, jocuma, jaguey (*Ficus membranacea*), macagua, guaguasi, jaguey (*Ficus suffucans*), yaya, yaba, jubabán, aguedita sweet and bone.

In the shrub layer with a fundamentally media covers (20-30%, exceptionally 60%) and herbaceous low to high (10-90%) are observed as seedlings and small trees: aguedita (*Picramnia pentandra*), raspalengua, ramon horse, guara, guarano, leviza, almendrillo (*Prunus myrtifolia*), ocuje (*Calophyllum antillanum*), guayabillo (*Guettarda calyptata*), sweet potato laurel (*Ocotea floribunda*), caimitillo, pole box and aguedita (*Celtis trinervia*). Other species of these layers and sinusiaes are found in Table 25.

Oecotope characteristics. This forest is developed in the upper and lower mogotes which are formed by denudation plateaus, and dissected sharply (Viña Bayés, 1991), composed for limestones and marbles. The altitude varies in the two study areas (Las Manuelas, 190-200 m asl) and (La Pimienta, 565-650 m asl), the slope is between 8 and 35 degrees and exposure is north to south-southeast.

The annual rainfall mean in this area is 1634 mm; from march to november the rainfall rate is over 100 mm while the dry season takes place from december to february, with only 15% of rainfall, so this area can be considered a tropical climate with dry winter, subtype 4cTh, with 3 to 4 dry months (moderately dry).

Table 23. Characteristic combination of amoroso with guásima (*Zanthoxylum fagara* with *Guazuma ulmifolia*, 3 plots).

| Species   | Vertica structure | Abundance-Coverage | Presence Degree |
|---|-------------------|--------------------|-----------------|
| Canopy + shrub layers                             |                   |                    |                 |
| <i>Guazuma ulmifolia</i>                          | D                 | 3                  | V               |
| <i>Senna atomaria</i>                             | C                 | 3                  | V               |
| <i>Cupania americana</i>                          | C                 | 1                  | V               |
| <i>Cupania glabra</i>                             | C                 | 1                  | V               |
| <i>Acacia macracantha</i>                         | C                 | 1                  | V               |
| <i>Samanea saman</i>                              | C                 | 1                  | V               |
| <i>Zanthoxylum fagara</i>                         | I                 | 1                  | V               |
| <i>Casearia hirsuta</i>                           | I                 | 1                  | V               |
| <i>Chrysophyllum oliviforme</i>                   | I                 | 1                  | V               |
| <i>Phyllostylon brasiliensis</i>                  | D                 | 1                  | IV              |
| <i>Leucaena leucocephala</i>                      | C                 | 1                  | IV              |
| Shrub layer                                       |                   |                    |                 |
| <i>Eugenia floribunda</i>                         | -                 | 1                  | IV              |
| <i>Picramnia pentandra</i>                        | -                 | 1                  | IV              |
| <i>Lonchocarpus blainii</i>                       | -                 | 1                  | IV              |
| <i>Casearia sylvestris</i> var. <i>sylvestris</i> | -                 | 1                  | IV              |
| <i>Psidium guajava</i>                            | -                 | 1                  | IV              |
| Herbaceous layer                                  |                   |                    |                 |
| <i>Chromolaena odorata</i>                        | -                 | 1                  | V               |
| <i>Erythroxylum havanense</i>                     | -                 | 1                  | V               |
| <i>Rivina humilis</i>                             | -                 | 1                  | V               |
| <i>Commelina elegans</i>                          | -                 | 1                  | V               |
| <i>Petiveria alliacea</i>                         | -                 | 1                  | V               |
| <i>Abutilon</i> sp.                               | -                 | 1                  | V               |
| <i>Pavonia typhalea</i>                           | -                 | 1                  | V               |
| <i>Trichilia hirta</i>                            | -                 | 1                  | IV              |
| <i>Spermacoce laevis</i>                          | -                 | 1                  | IV              |
| <i>Desmanthus virgatus</i>                        | -                 | 1                  | IV              |
| <i>Phyla nodiflora</i>                            | -                 | 1                  | IV              |
| <i>Turnera ulmifolia</i>                          | -                 | 1                  | IV              |
| <i>Rauvolfia tetraphylla</i>                      | -                 | 1                  | IV              |
| <i>Desmodium incanum</i>                          | -                 | 1                  | IV              |
| <i>Adiantum trapeziforme</i>                      | -                 | 1                  | IV              |
| <i>Varronia globosa</i> ssp. <i>humilis</i>       | -                 | 1                  | IV              |
| <i>Oeceoclades maculata</i>                       | -                 | 1                  | IV              |
| Lianas  |                   |                    |                 |
| <i>Gouania lupuloides</i>                         | -                 | 1                  | V               |
| <i>Pisonia aculeata</i>                           | -                 | 1                  | V               |
| <i>Serjania diversifolia</i>                      | -                 | 1                  | V               |
| <i>Turbina corymbosa</i>                          | -                 | 1                  | V               |
| <i>Trichostigma octandrum</i>                     | -                 | 1                  | IV              |
| <i>Smilax havanense</i>                           | -                 | 1                  | IV              |
| <i>Lasiasis divaricata</i>                        | -                 | 1                  | IV              |
| <i>Cissampelos pareira</i>                        | -                 | 1                  | IV              |
| <i>Chiococca alba</i>                             | -                 | 1                  | IV              |
| <i>Tournefortia hirsutissima</i>                  | -                 | 1                  | IV              |
| <i>Centrosema</i> sp.                             | -                 | 1                  | IV              |
| <i>Stigmaphyllon lineare</i>                      | -                 | 1                  | IV              |
| <i>Stigmaphyllon sagreanum</i>                    | -                 | 1                  | IV              |

Scattered species in the canopy layer: anacahuita, ayúa, yamagua, yagruma, *Citharexylum* sp., jobo, sigua, royal palm, pomarrosa (*Zyzygium jambos*), jagua, cedar, tengue, corajo (*Gastrococos crispa*) and jocuma.

Table 24. Characteristic combination of sigua with guara (*Ocotea coriacea* with *Cupania glabra*, 6 plots)

| Species                                  | Vertical structure | Abundance-Coverage | Presence Degree |
|--|--------------------|--------------------|-----------------|
| Canopy layer                             |                    |                    |                 |
| <i>Ocotea coriacea</i>                   | D                  | 2                  | V               |
| <i>Cupania glabra</i> var. <i>glabra</i> | C                  | 1                  | V               |
| <i>Ficus laevigata</i>                   | C                  | 1                  | V               |
| <i>Guapira obtusata</i>                  | C                  | 1                  | V               |
| <i>Plumeria emarginata</i>               | I                  | 1                  | V               |
| <i>Amyris elemifera</i>                  | C                  | 1                  | IV              |
| <i>Drypetes alba</i>                     | C                  | 1                  | IV              |
| <i>Celtis trinervia</i>                  | I                  | 1                  | IV              |
| <i>Dendropanax arboreus</i>              | C                  | 1                  | IV              |
| <i>Abarema glauca</i>                    | C                  | 1                  | III             |
| <i>Zanthoxylum cubense</i>               | C                  | 1                  | III             |
| <i>Cordia gerascanthus</i>               | C                  | 1                  | III             |
| <i>Citharexylum caudatum</i>             | I                  | 1                  | III             |
| Shrub layer                              |                    |                    |                 |
| <i>Hyperbaena paucinervis</i>            | -                  | 1                  | V               |
| <i>Picramnia pentandra</i>               | -                  | 1                  | V               |
| <i>Cojoba arborea</i>                    | -                  | 1                  | IV              |
| <i>Casearia hirsuta</i>                  | -                  | 1                  | IV              |
| <i>Eugenia asperifolia</i>               | -                  | 1                  | IV              |
| Herbaceous layer                         |                    |                    |                 |
| <i>Faramea occidentalis</i>              | -                  | 1                  | V               |
| <i>Pharus glaber</i>                     | -                  | 1                  | IV              |
| <i>Zamia angustifolia</i>                | -                  | 1                  | IV              |
| Lianas                                   |                    |                    |                 |
| <i>Chiococca alba</i>                    | -                  | 1                  | V               |
| <i>Philodendron lacerum</i>              | -                  | 1                  | V               |
| <i>Selenicereus grandiflorus</i>         | -                  | 1                  | V               |
| <i>Smilax havanensis</i>                 | -                  | 1                  | V               |
| <i>Lasiacis divaricata</i>               | -                  | 1                  | IV              |
| <i>Pisonia aculeata</i>                  | -                  | 1                  | III             |
| <i>Smilax lanceolata</i>                 | -                  | 1                  | III             |
| <i>Vanilla</i> sp.                       | -                  | 1                  | III             |
| Epiphytes                                |                    |                    |                 |
| <i>Hohenbergia penduliflora</i>          | -                  | 1                  | V               |
| <i>Trichocentrum undulatum</i>           | -                  | 1                  | V               |
| <i>Tillandsia fasciculata</i>            | -                  | 1                  | V               |
| <i>Tillandsia usneoides</i>              | -                  | 1                  | IV              |
| <i>Peperomia magnoliaefolia</i>          | -                  | 1                  | III             |
| <i>Rhipsalis cassutha</i>                | -                  | 1                  | III             |
| <i>Pleurothallis sertularioides</i>      | -                  | 1                  | III             |
| <i>Tillandsia pruinosa</i>               | .                  | 1                  | III             |

Scattered species in the canopy layer: carmin, roble macho (*Tabebuia hypoleuca*), aguedita dulce, palo de caja, yaya, yaicuaaje, *Ficus perforata*, guayabillo (*Guettarda calyptrata*), yaití, royal palm, *combretaceae*, leviza (*Licaria jamaicensis*), *Pithecellobium* sp., guaguasi, canilla de venado (*Citharexylum fruticosum*), cupey (*Clusia rosea*), macagua (*Pseudolmedia spuria*), yellow jucaro (*Buchenavia (tetrphylla) capitata*), dominguito (*Chionanthus domingensis*), cuyá, *Tabebuia* sp., carbonero, maboa (*Cameraria latifolia*), chicharrón, ayúa, yagruma, ceiba, guásima and cedar.

Localities: Carso de Baire.

Table 25. Characteristic combination of yamagua with ramon cow  
(*Guarea guidonia* with *Dendropanax arboreus*, 3 plots)

| Species  | Vertical structure | Abundance-Coverage | Presence Degree |
|--|--------------------|--------------------|-----------------|
| Canopy layer   |                    |                    |                 |
| <i>Dendropanax arboreus</i>                                  | D                  | 3                  | V               |
| <i>Guarea guidonia</i>                                       | D                  | 2                  | V               |
| <i>Cordia gerascanthus</i>                                   | D                  | 1                  | V               |
| <i>Ocotea coriacea</i>                                       | D                  | 1                  | V               |
| <i>Zanthoxylum martinicense</i>                              | D                  | 1                  | V               |
| <i>Cecropia peltata</i>                                      | C                  | 1                  | V               |
| <i>Roystonea regia</i>                                       | C                  | 1                  | V               |
| <i>Guazuma ulmifolia</i>                                     | C                  | 1                  | IV              |
| <i>Cedrela cubensis</i>                                      | C                  | 1                  | III             |
| <i>Spondias mombin</i>                                       | C                  | 2                  | III             |
| <i>Sideroxylon foetidissimum</i> subsp. <i>foetidissimum</i> | C                  | 1                  | III             |
| <i>Ficus membranacea</i>                                     | C                  | 1                  | III             |
| <i>Pseudolmedia spuria</i>                                   | C                  | 1                  | III             |
| <i>Zuelania guidonia</i>                                     | C                  | 1                  | III             |
| <i>Bursera simaruba</i>                                      | C                  | 1                  | III             |
| <i>Ficus suffucans</i>                                       | C                  | 1                  | III             |
| <i>Oxandra lanceolata</i>                                    | I                  | 2                  | III             |
| <i>Geoffroea inermis</i>                                     | I                  | 1                  | III             |
| <i>Trichilia hirta</i>                                       | I                  | 1                  | III             |
| <i>Casearia sylvestris</i> var. <i>sylvestris</i>            | I                  | 1                  | III             |
| <i>Drypetes alba</i>   | I                  | 1                  | III             |
| Shrub layer  |                    |                    |                 |
| <i>Picramnia pentandra</i>                                   | -                  | 1                  | V               |
| <i>Casearia hirsuta</i>                                      | -                  | 1                  | V               |
| <i>Trophis racemosa</i>                                      | -                  | 1                  | V               |
| <i>Cupania glabra</i>  | -                  | 1                  | V               |
| <i>Licaria jamaicensis</i>                                   | -                  | 1                  | IV              |
| <i>Prunus myrtifolia</i>                                     | -                  | 1                  | IV              |
| <i>Calophyllum antillanum</i>                                | -                  | 1                  | III             |
| <i>Guettarda calyptata</i>                                   | -                  | 1                  | III             |
| <i>Coffea arabica</i>  | -                  | 1                  | III             |
| <i>Ocotea floribunda</i>                                     | -                  | 1                  | III             |
| <i>Erythroxylum areolatum</i>                                | -                  | 1                  | III             |
| Herbaceous layer   |                    |                    |                 |
| <i>Cupania americana</i>                                     | -                  | 1                  | V               |
| <i>Pharus glaber</i>   | -                  | 1                  | V               |
| <i>Adiantum trapeziforme</i>                                 | -                  | 1                  | V               |
| <i>Erythroxylum havanense</i>                                | -                  | 1                  | IV              |
| <i>Pavonia spinifex</i>                                      | -                  | 1                  | IV              |
| <i>Oeceoclades maculata</i>                                  | -                  | 1                  | IV              |
| <i>Oplismenus setarius</i>                                   | -                  | 1                  | IV              |
| <i>Chrysophyllum oliviforme</i>                              | -                  | 1                  | III             |
| <i>Psychotria</i> sp.  | -                  | 1                  | III             |
| <i>Lithacne pauciflora</i>                                   | -                  | 1                  | III             |
| <i>Allophyllus cominia</i>                                   | -                  | 1                  | III             |
| <i>Celtis trinervia</i>                                      | -                  | 1                  | III             |
| <i>Faramea occidentalis</i>                                  | -                  | 1                  | III             |
| <i>Anthurium cubense</i>                                     | -                  | 1                  | III             |
| <i>Urera baccifera</i>                                       | -                  | 1                  | III             |
| Lianas   |                    |                    |                 |
| <i>Cissus verticillata</i>                                   | -                  | 1                  | V               |
| <i>Pithecoctenium echinatum</i>                              | -                  | 1                  | IV              |

|                                  |   |   |     |
|----------------------------------|---|---|-----|
| <i>Pisonia aculeata</i>          | - | 1 | IV  |
| <i>Gouania lupuloides</i>        | - | 1 | IV  |
| <i>Abrus precatorius</i>         | . | 1 | IV  |
| <i>Trichostigma octandrum</i>    | - | 1 | III |
| <i>Hyperbaena</i> sp.            | - | 1 | III |
| <i>Passiflora suberosa</i>       | - | 1 | III |
| <i>Tournefortia glabra</i>       | - | 1 | III |
| <i>Chiococca alba</i>            | - | 1 | III |
| <i>Serjania subdentata</i>       | - | 1 | III |
| <i>Philodendron lacerum</i>      | - | 1 | III |
| Epiphytes                        |   |   |     |
| <i>Tillandsia fasciculata</i>    | - | 1 | IV  |
| <i>Tillandsia usneoides</i>      | - | 1 | III |
| <i>Campiloneurum phyllitidis</i> | - | 1 | III |

Scattered species in the canopy layer: bucare (*Erythrina poeppigiana*), *Ficus laevigata*, dominguito, yaicuaaje, toad (*Ocotea leucoxylon*), penda, tabaco (*Cordia sulcata*), bien vestido (*Gliricidia sepium*), lechero (*Tabernaemontana amblyocarpa*), comecará (*Eugenia aeruginea*), siguaralla (*Trichilia havanensis*), aceitunillo (*Beilschmiedia pendula*), ayúa de sierra, moruro rojo (*Cojoba arborea*), dagame, *Thouinia* sp., cupey, guamá candelón, *Eugenia* sp., tengue, mije (*Eugenia floribunda*), yellow jucaró, cuajani (*Prunus occidentalis*), dairy and guairaje (*Eugenia axillaris*).

It occurs where the ecological conditions are most favorable. Its topographic position, protected by narrow valleys between the mogotes, or rock masses in the upper part thereof, makes for limited exposure to the sunlight and natural windshield; this reduces the air circulation and its effect on evaporation - transpiration. Because this set of factors, the water regime is relatively friendly.

The soil is brownish sialtíc (Hernández & al., 1994), reddish, from shallow to moderately deep, with limestone rocks on the surface, which cover between 5 and 80%. The L layer has between 1.5 and 3 cm, the F layer varies from traces to 0.2 cm (with rootlets) and H is missing. In this forest, whose cycle of nutrients depends on the soil, the rate of withered leaves decomposition seems to be very quick (Herrera & Rodriguez, 1988). Therefore, the edatope is considered fresh (2) and moderately fertile (B), so that the potential production capacity is considered as regular (III). The typology classification is considered B<sub>x-xxx</sub>2, 4cTh<sub>d</sub>, III, G.g., D.a.

Distribution. It is present in the area known as Carso de Baire.

Terms for forest management. This type of forest is rich in tree species, so it must be handled in order to obtain maximum development, freeing up the tops of the valuable species. Subsequently, extractions will be performed selectively.

### **Yaya with jobo (*Spondias mombin* with *Oxandra lanceolata*)**

It consists of a gallery forest whose corresponding table is not presented since the mini-

imum number of samples is nonexistent (2 plots). The canopy layer has two sublayers, the upper one is about 20 m high, with emergents of 25 m, sometimes this layer reaches the latter height; the lower layer on the other hand is from 8 to 10 m high, occasionally between 12 to 15 m; with a dense covert (100%). In general there are 41 tree species present, the most abundant are: jobo (D, AC 3), yaya (I, AC 2-3), yagruma (C, AC 2), guásima (D, AC 2), yamagua (D, AC 2), ramon cow (C, AC 2) and macagua (D, AC 2). There are also constant, although not abundant: sigua (D, AC 1), guarano (C, AC 1), guara (I, AC 1), royal palm (P, AC 1), jocuma (C, AC 1), jaguey male (*Ficus membranacea*, I, AC 1), jubabán (I, AC 1), ramon horse (C, AC 1), ayua (C, AC 1), guaguasi (I, AC 1), almacigo (I, AC 1), yaba (I, AC 1), raspalengua (I, AC 1), baria (I, AC 1), ocuje (C, AC 1) and caimitillo (0, AC 1). As spread tree species there can be observed: moruro rojo (I, AC 1), cupey (*Clusia rosea*, I, AC 1), dagame (I, AC 1), *Thouinia* sp. (0, AC 1), leviza (0, AC 1), guamá candelón (I, AC 1), washing jaguey (*Ficus suffucans*, I, AC 1), guairaje (*Eugenia* sp., 0, AC 1), aguedita sweet (I, AC 1), saithe arabic (*Erythroxylum areolatum*, I, AC 1), tengue (0, AC 1), mije (*Eugenia floribunda*, 0, AC 1), bone (0, AC 1), yellow jucaró (C, AC 1), cuajani (C, AC 1), almendrillo (I, AC 1), dairy (*Sapium jamaicense*, I, AC 1) and guairaje (*Eugenia axillaris*, 0, AC 1).

The shrub layer has a media covert (20-30%) and it is composed almost entirely of tree species. This covert is low in the herbaceous layer (approx. 10%) and near half of its composition is tree species.

Oecotope characteristics. Located near the river in the bottom of the slope and consequently receives the contribution of the runoff thereof. Besides, due to its topographic position it is affected by the gravitational night winds. Therefore, the water balance is favorable. The height is between 190 and 200 m a.s.l, the inclination from 8 to 35 degrees and exposure between east and north. The mean annual temperature is around 24 °C. The mean annual rainfall is between 1400 and 1600 mm, so it is considered moderately rainy. The relative humidity varies from 80 to 85%, whereas the evaporation varies from 1 500 and 1 700 mm. For that reason, it is considered a tropical climate with dry winter, subtype 4cTh, with 3-4 (moderately dry) dry months.

It is located on rocks of the Cobre Group, the soil is sialitic brown, deep, with gravel (20%); in addition it has 40 to 100% of rocks at the surface. Therefore the edatope is considered moderately wet (3) and fertile (C) and the potential productive capacity as good (II). The layers of humus are not well developed, the L is between 3.5 and 5 cm thick, covering about 80% of the surface, F is almost imperceptible, scattered among the rocks and gravel, while H is lacking. This type of withered leaves decomposition is known as quick.

The typology classification is as follows C<sub>xx-xxx</sub>3, 4cTh<sub>c-d</sub> II, O.I., S.m.

Distribution. The study was run at the middle of the Turquino river.

Terms for forest management. Due to its small size this forest should be preserved from any human activity. In the zone there are areas where it should be restored to mixed forests with the same species as currently presented.

### **Almendrillo with yamagua (*Prunus myrtifolia* with *Guarea guidonia*; Table 26)**

Physiognomy and floristic composition. This evergreen forest (mesophytic) has a canopy layer with 24 species of trees (average samples), it is from 12 to 25 m high and its covert is dense (90-100%). In the group of constant species there are as main species yamagua and ramon cow; as subdominants: boniatillo (*Cinnamomum elongatum*), toad (*Ocotea leucoxydon*), ayua, guarano, caimitillo, ramon horse, almendrillo, dominguito and aceitunillo (*Beilschmiedia pendula*). In the group of accompanying species there are as subdominant species: cuajani, royal palm, sweet potato, laurel, macagua, palma boba (*Prestoea acuminata* var. *montana*), sweet aguedita, mije (*Eugenia floribunda*) and copal (*Protium cubense*). In turn, the aggregate

species observed are moruro rojo, aguacatillo (*Alchornea latifolia*), yaicuaje (*Matayba oppositifolia*), dairy, *Ocotea globosa*, marañon de costa (*Talauma orbiculata*), jaguey male (*Ficus membranacea*) and bone.

In the shrub layer, with a media covert and 12.2 tree species (average samples) there are as aggregate: pole box, cupey, casmagua (*Wallenia laurifolia*) and manaca (*Calyptronoma plumeriana*). The other species of the shrub and herbaceous layers (covert media to high and 13.5 average tree species), ferns and lianas are found in Table 26.

Oecotope characteristics. It usually develops between 500 and 800 m asl (locally up to 900 m above sea level on the south side), the slopes vary between 30 and 40 degrees and the exposure are varied. The microrelief is generally flat. This forest occurs in evergreen forest floor; climate is tropical with dry winter, 4cTh subtype, 3 to 4 months with little rain (moderately dry). The rainfall varies between 1200 and 1800 mm of rain, a moderately rainy, with large differences in their length; the dry season is from November to April and rainy from May to October (Montenegro 1991a, b). The average annual temperature is relatively cool, fluctuates between 22 and 23 °C at the bottom and around 20 °C at the top. At these altitudes (below 800 m asl), in the evenings and in mid-april to late October, relative insolation varies between 20 and 30%, the rest of these months is 30 to 40%. In the morning ranges from 40 to 60% (Montenegro, 1991e). This lowers the effect of drought.

It occurs on soils derived from rock the Cobre Group, mostly andesites, and these are mainly ferralitic brown, low to very shallow, sometimes with stones on the surface. The withered leaves are well developed, the L layer is between 2 and 7 cm thick; F varies from 0.5 to 3 cm, whereas H is missing; nanodepressions sometimes in humus accumulations are observed with roots and rootlets. Therefore, it is considered as fresh edatopes (2) and moderately fertile (B), so that their potential production capacity is rated as regular (III). The typology classification is as follows B2, 4cTh<sub>c-d</sub> III, P.m., G.g.

Distribution. This type represents the submountain forests of the Sierra Maestra, i.e. evergreen mesophyllous forests (mesophytic), which were designated as manacales by León (1946) and as canelones by Samek (1974). At the top transitions of the mountain rainforests and bottom with mesophytic semi-deciduous forests. They were studied in the Sierra of Gran Piedra and Turquino river basin.



Table 26. Characteristic combination of almendrillo with yamagua (*Prunus myrtifolia* with *Guarea guidonia*, 4 plots)

| Species   | Vertical structure | Abundance-Coverage | Presence Degree |
|---|--------------------|--------------------|-----------------|
| Canopy layer                                      |                    |                    |                 |
| <i>Guarea guidonia</i>                            | D                  | 2                  | V               |
| <i>Dendropanax arboreus</i>                       | D                  | 2                  | V               |
| <i>Prunus myrtifolia</i>                          | C                  | 1                  | V               |
| <i>Ocotea leucoxylo</i>                           | C                  | 1                  | V               |
| <i>Cinnamomum elongatum</i>                       | C                  | 1                  | V               |
| <i>Zanthoxylum martinicense</i>                   | C                  | 1                  | V               |
| <i>Cupania americana</i>                          | C                  | 1                  | V               |
| <i>Trophis racemosa</i>                           | C                  | 1                  | V               |
| <i>Chionanthus domingensis</i>                    | C                  | 1                  | V               |
| <i>Beilschmiedia pendula</i>                      | C                  | 1                  | V               |
| <i>Chrysophyllum oliviforme</i>                   | I                  | 1                  | V               |
| <i>Prunus occidentalis</i>                        | C                  | 1                  | IV              |
| <i>Roystonea regia</i>                            | C                  | 1                  | IV              |
| <i>Ocotea floribunda</i>                          | C                  | 1                  | IV              |
| <i>Pseudolmedia spuria</i>                        | C                  | 1                  | IV              |
| <i>Prestoea acuminata</i> var. <i>montana</i>     | I                  | 1                  | IV              |
| <i>Casearia sylvestris</i> var. <i>sylvestris</i> | I                  | 1                  | IV              |
| <i>Eugenia floribunda</i>                         | I                  | 1                  | IV              |
| <i>Protium cubense</i>                            | I                  | 1                  | IV              |
| <i>Cojoba arborea</i>                             | C                  | 1                  | III             |
| <i>Alchornea latifolia</i>                        | C                  | 1                  | III             |
| <i>Matayba oppositifolia</i>                      | C                  | 1                  | III             |
| <i>Sapium jamaicense</i>                          | C                  | 1                  | III             |
| <i>Ocotea globosa</i>                             | C                  | 1                  | III             |
| <i>Talauma orbiculata</i>                         | C                  | 1                  | III             |
| <i>Ficus membranacea</i>                          | C                  | 1                  | III             |
| <i>Drypetes alba</i>                              | I                  | 1                  | III             |
| Shrub layer                                       |                    |                    |                 |
| <i>Allophyllus cominia</i>                        | -                  | 1                  | III             |
| <i>Gesneria</i> sp.                               | -                  | 1                  | III             |
| <i>Palicourea alpina</i>                          | -                  | 1                  | III             |
| <i>Clusia rosea</i>                               | -                  | 1                  | III             |
| <i>Wallenia laurifolia</i>                        | -                  | 1                  | III             |
| <i>Anthirea radiata</i>                           | -                  | 1                  | III             |
| <i>Piper</i> sp.                                  | -                  | 1                  | III             |
| <i>Calyptrotrichia plumeriana</i>                 | -                  | 1                  | III             |
| Herbaceous layer                                  |                    |                    |                 |
| <i>Oplismenus setarius</i>                        | -                  | 1                  | IV              |
| <i>Oeceoclades maculata</i>                       | -                  | 1                  | IV              |
| <i>Desmodium</i> sp.                              | -                  | 1                  | III             |
| <i>Faramea occidentalis</i>                       | -                  | 1                  | III             |
| <i>Psychotria</i> sp.                             | -                  | 1                  | III             |
| <i>Psychotria uliginosa</i>                       | -                  | 1                  | III             |
| <i>Pavonia spinifex</i>                           | -                  | 1                  | III             |
| <i>Lithachne pauciflora</i>                       | -                  | 1                  | III             |
| <i>Peperomia</i> sp.                              | -                  | 1                  | III             |
| Ferns   |                    |                    |                 |
| <i>Campyloneurum phyllitidis</i>                  | -                  | 2                  | V               |
| <i>Blechnum occidentale</i>                       | -                  | 1                  | V               |
| <i>Cyathea parvula</i>                            | -                  | 1                  | III             |
| <i>Adiantum trapeziforme</i>                      | -                  | 1                  | III             |

| Lianas                        |   |   |     |
|-------------------------------|---|---|-----|
| <i>Vitis tiliaefolia</i>      | - | 1 | V   |
| <i>Pisonia aculeata</i>       | - | 1 | V   |
| <i>Gouania lupuloides</i>     | - | 1 | V   |
| <i>Lygodium volubile</i>      | - | 1 | V   |
| <i>Hyperbaena paucinervis</i> | - | 1 | IV  |
| <i>Trichostigma octandrum</i> | - | 1 | IV  |
| <i>Davila rugosa</i>          | - | 1 | IV  |
| <i>Smilax lanceolata</i>      | - | 1 | IV  |
| <i>Hippocratea volubilis</i>  | - | 1 | III |
| <i>Cissampelos pareira</i>    | - | 1 | III |
| <i>Passiflora sexflora</i>    | - | 1 | III |
| <i>Smilax havanensis</i>      | - | 1 | III |
| <i>Serjania diversifolia</i>  | - | 1 | III |

Scattered species in the canopy layer: bucare, camaguilla (*Myrsine coriacea*), cuero (*Guettarda monocarpa*), penda, *Clusia* sp., *Colubrina* sp., *Cassia* sp., aguedita (*Picramnia pentandra*), yareicillo (*Myrcia fenzliana* = *Gomidesia Lindeniana*), pomarrosa, yaya, *Ocotea globosa*, jubilla (*Sideroxylon jubilla*), roble blanco (*Tabebuia angustata*), guaguasi, jocuma, *Thouinia* sp., yaicuaje, sarnilla cimarrona (*Casearia sylvestris* var. *myricoides*), cedar, yagruma hembra (*Schefflera morototoni*), purio (*Oxandra laurifolia*) and ateje (*Cordia collococca*).

Forest management. These forests are rich in tree species and have been very impoverished, especially for growing coffee, meats and pastures, so the few remnants are severely threatened and must be protected. Many for this type of forest oecotopes should be restored to mixed forests, mainly: cedar, jubilla, jocuma, yamagua, boniatillo, almendrillo, cuajaní, sweet potato laurel, coast marañon, ateje, purio, guarano, ayua, etc.

#### **Dominguito with palma boba (*Chionanthus domingensis* with *Prestoea acuminata* var. *montana*; Table 27)**

Physiognomy and floristic composition. This type of forest is a mountain rainforest. The height and density of the canopy layer (averaging 15.5 species among samples) are presented fairly uniform; height fluctuates between 12 and 15 m, while coverage is dense (90-100%). In the group of constant species, palma boba, ramon cow and dominguito are main species; while toad, canelón (*Ocotea cuneata*), guáran, yaicuaje, aceitunillo and yareicillo (*Myrcia fenzliana*) are subdominants. In the group of accompanying species, cupey (*Clusia tetrastigma*), barril, pomarrosa and boniatillo are subdominants, while in the group of aggregated species are, cuajaní and purio fangar (*Guatteria neglecta*).

The shrub and herbaceous layers with a covers from media to high (40-70%) and high (50-90%) respectively, ferns, lianas synusiaes and epiphytes are found in Table 27.

Oecotope characteristics. It takes place between 800 and 1120 m asl, the inclination is among 30 and 45 degrees, and exposures are mainly to the north.

The weather station in Gran Piedra reports the following data (Montenegro, 1990): 29 °C as absolute maximum temperature, 6 °C as absolute minimum temperature, 18.4 °C as average temperature, relative humidity at 89.6%, mean annual rainfall of 1664 mm (rainy), 139 days with rain on average, sunshine average 5 to 7 hours / day. Prevailing winds are the trade's from the northeast and north-northeast, which in turn are also the strongest. The average number of days with horizontal precipitation (fog and low cloud) is 238; of them 162 days are with dense fog (Montenegro, 1990). These horizontal precipitations, according Boytel Yambú (1972), come to moisten the soil and vegetation; while Samek & Travieso (1968) exposed that they can represent up to 50% of rainfall. Therefore, their importance as moisture providers is critical, as well as for limiting its loss in the ecosystem. Bioclimatically, the climate is moist Tropical Mountain (7a). Vilamajó & al. (1989) considered it as of termoxeric type (wet equatorial).

Soil is leachate red ferralitic (sensu Hernández & al., 1994) or yellowish brown. It derived from rocks of the Cobre Group, mainly from andesites. It is very poor (Renda, 1989; Renda & al., 1980, 1981), moderately fertile (B) and fresh (2), so its potential productive capacity is considered regular (III). It has good internal and surface drainage. The

withered leaves are well distributed on the surface; the L layer reaches from 3 to 5 cm; F and H layers are mixed, sometimes forming a weft that can reach up to 10 cm thick, sometimes it gets to be a real root mat. The

typology classification is as follows B2, 7a<sub>e</sub>, III, Rm\*, Ch.d., Pa.

Distribution. It comes in the top of Sierra of Gran Piedra, from 800 m asl in the north side and locally 900 m asl in the south.

Table 27. Characteristic combination of dominguito with palma boba (*Chionanthus domingensis* with *Prestoea acuminata*, 9 plots)

| Species   | Vertical structure | Abundance-Coverage | Presence Degree |
|---|--------------------|--------------------|-----------------|
| Canopy layer  |                    |                    |                 |
| <i>Chionanthus domingensis</i>                          | D                  | 2                  | V               |
| <i>Prestoea acuminata</i> var. <i>montana</i>           | D                  | 2                  | V               |
| <i>Dendropanax arboreus</i>                             | D                  | 2                  | V               |
| <i>Ocotea leucoxydon</i>                                | D                  | 1                  | V               |
| <i>Cupania americana</i>                                | C                  | 1                  | V               |
| <i>Matayba oppositifolia</i>                            | C                  | 1                  | V               |
| <i>Ocotea cuneata</i>                                   | C                  | 1                  | V               |
| <i>Beilschmiedia pendula</i>                            | C                  | 1                  | V               |
| <i>Myrcia fenzliana</i> ( <i>Gomidesia lindeniana</i> ) | I                  | 1                  | V               |
| <i>Clusia tetrastigma</i>                               | I                  | 2                  | IV              |
| <i>Cyrilla silvae</i>                                   | C                  | 1                  | IV              |
| <i>Syzygium jambos</i>                                  | C                  | 1                  | IV              |
| <i>Cinnamomum elongatum</i>                             | C                  | 1                  | IV              |
| <i>Prunus occidentalis</i>                              | C                  | 1                  | III             |
| <i>Guatteria neglecta</i>                               | C                  | 1                  | III             |
| Shrub layer   |                    |                    |                 |
| <i>Gesneria viridiflora</i>                             | -                  | 1                  | V               |
| <i>Lyonia latifolia</i> subsp. <i>calycosa</i>          | -                  | 1                  | III             |
| <i>Ilex</i> sp.   | -                  | 1                  | III             |
| Herbaceous layer  |                    |                    |                 |
| <i>Callicarpa oblanceolata</i>                          | -                  | 1                  | V               |
| <i>Psychotria grandis</i>                               | -                  | 1                  | V               |
| <i>Phaius tankervilleae</i>                             | -                  | 1                  | IV              |
| <i>Palicourea alpina</i>                                | -                  | 1                  | IV              |
| <i>Hedyosmum grisebachii</i>                            | -                  | 1                  | IV              |
| <i>Meriania leucantha</i> var. <i>nana</i>              | -                  | 1                  | IV              |
| <i>Oplismenus setarius</i>                              | -                  | 1                  | IV              |
| <i>Columnea cubensis</i>                                | -                  | 1                  | IV              |
| <i>Peperomia</i> sp. 1                                  | -                  | 1                  | III             |
| <i>Coccoloba</i> sp.                                    | -                  | 1                  | III             |
| <i>Peperomia</i> sp. 2                                  | -                  | 1                  | III             |
| Ferns   |                    |                    |                 |
| <i>Cyathea parvula</i>                                  | -                  | 1                  | V               |
| <i>Blechnum occidentale</i>                             | -                  | 1                  | V               |
| <i>Cyathea aspera</i>                                   | -                  | 2                  | IV              |
| Lianas  |                    |                    |                 |
| <i>Philodendrum lacerum</i>                             | -                  | 1                  | III             |
| Epiphytes   |                    |                    |                 |
| <i>Guzmania monostachya</i>                             | -                  | 1                  | V               |
| <i>Campiloneurum phyllitidis</i>                        | -                  | 1                  | III             |
| <i>Diplazium</i> sp.                                    | -                  | 1                  | III             |

Scattered species in the canopy layer: moruro rojo, sarnilla cimarrona, *Ficus* sp., palo de caja, aguacatillo, cletra (*Clethra cubensis*), guayacanejo (*Coccoloba diversifolia*), camaguilla (*Myrsine coriacea*), brunelia (*Brunellia comocladifolia*), roble macho (*Tabebuia hypoleuca*), almendrillo, roble blanco (*Tabebuia angustata*), marañón (*Talauma* sp.), penda, *Ocotea globosa*, yagruma, mije (*Eugenia floribunda*), cuero (*Guettarda monocarpa*), macagua, aguedita dulce, *Hieronyma pallida*, cupey (*Clusia rosea*), achotillo (*Sloanea curatellifolia*).

Table 28. Characteristic combination of yareicillo with copey  
(*Myrcia fenziiana* (*Gomidesia lindeniana*) with *Clusia tetrastigma*, 8 plots

| Species   | Vertical structure | Abundance-Coverage | Presence Degree |
|---|--------------------|--------------------|-----------------|
| Canopy layer  |                    |                    |                 |
| <i>Clusia tetrastigma</i>                               | D                  | 3                  | V               |
| <i>Myrcia fenziiana</i> ( <i>Gomidesia lindeniana</i> ) | I                  | 2                  | V               |
| <i>Eugenia scaphophylla</i>                             | C                  | 1                  | V               |
| <i>Matayba oppositifolia</i>                            | C                  | 1                  | V               |
| <i>Ocotea leucoxydon</i>                                | C                  | 1                  | V               |
| <i>Coccoloba diversifolia</i>                           | C                  | 1                  | V               |
| <i>Alchornea latifolia</i>                              | C                  | 1                  | V               |
| <i>Clethra cubensis</i>                                 | I                  | 1                  | V               |
| <i>Cyrilla silvae</i>                                   | C                  | 1                  | IV              |
| <i>Lyonia latifolia</i> subsp. <i>calycosa</i>          | I                  | 1                  | IV              |
| <i>Myrica cerifera</i>                                  | I                  | 1                  | III             |
| Shrub layer   |                    |                    |                 |
| <i>Ilex macfadyenii</i>                                 | -                  | 1                  | V               |
| <i>Ossaea granulata</i>                                 | -                  | 1                  | V               |
| <i>Palicourea alpina</i>                                | -                  | 1                  | V               |
| <i>Gesneria viridiflora</i>                             | -                  | 1                  | V               |
| <i>Myrsine coriacea</i>                                 | -                  | 1                  | V               |
| <i>Ilex repanda</i>                                     | -                  | 1                  | IV              |
| <i>Citharexylum</i> sp.                                 | -                  | 1                  | IV              |
| <i>Guettarda valenzuelana</i>                           | -                  | 1                  | III             |
| <i>Coccoloba wrightii</i>                               | -                  | 1                  | III             |
| Herbaceous layer  |                    |                    |                 |
| <i>Scleria lithosperma</i>                              | -                  | 1                  | V               |
| <i>Panicum glutinosum</i>                               | -                  | 1                  | V               |
| <i>Psychotria</i> sp.                                   | -                  | 1                  | IV              |
| <i>Chionanthus domingensis</i>                          | -                  | 1                  | IV              |
| <i>Prestoea acuminata</i> var. <i>montana</i>           | -                  | 1                  | IV              |
| <i>Eupatorium</i> sp.                                   | -                  | 1                  | IV              |
| <i>Phaius tankervilleae</i>                             | -                  | 1                  | IV              |
| <i>Olyra latifolia</i>                                  | -                  | 1                  | IV              |
| <i>Ichnanthus mayarensis</i>                            | -                  | 1                  | IV              |
| <i>Vernonia hieracioides</i>                            | -                  | 1                  | III             |
| <i>Oplismenus setarius</i>                              | -                  | 1                  | III             |
| <i>Cinnamomum elongatum</i>                             | -                  | 1                  | III             |
| <i>Piper</i> sp.  | -                  | 1                  | III             |
| <i>Chaptalia</i> sp.                                    | -                  | 1                  | III             |
| Ferns   |                    |                    |                 |
| <i>Cyathea parvula</i>                                  | -                  | 3                  | V               |
| <i>Sticherus bifidus</i>                                | -                  | 1                  | IV              |
| <i>Blechnum occidentale</i>                             | -                  | 1                  | IV              |
| <i>Cyathea aspera</i>                                   | -                  | -                  | III             |
| <i>Odontosoria scandens</i>                             | -                  | 1                  | III             |
| Lianas  |                    |                    |                 |
| <i>Smilax havanensis</i>                                | -                  | 1                  | V               |
| <i>Smilax lanceolata</i>                                | -                  | 1                  | IV              |
| <i>Arthrostylidium multispicatum</i>                    | -                  | 1                  | IV              |
| Epiphytes   |                    |                    |                 |
| <i>Isochilus linearis</i>                               | -                  | 1                  | IV              |
| <i>Tillandsia fasciculata</i>                           | -                  | 1                  | IV              |
| <i>Guzmania monostachya</i>                             | -                  | 1                  | IV              |
| <i>Dichaea hystericina</i>                              | -                  | 1                  | III             |

Scattered species in the canopy layer: aguedita dulce, ramon cow, cuero, guárano, cedar, cupey, roble macho, pomarrosa, purio prieto (*Guatteria blainii*), palo de caja, aceitunillo and canelón.

Forest management. This rainforest is of inestimable hydrologic value, and also as protector of a very erodible soil. It has been highly altered; only relatively preserved relicts are left. It must be protected from any human intervention since it is part of a Biosphere Reserve (also Protected Area of Managed Resources) and it is its main object of conservation. Only controlled observation of its values and scientific research should be allowed.

**Yareicillo with copey [*Myrcia fenziiana* (*Gomidesia lindeni*) with *Clusia tetragyna*; Table 28]**

Physiognomy and floristic composition. This forest is a successional stage (homeostasis I and early fieria II) (sensu Capote & al., 1988; Reyes & Acosta, 2005) of the mountain rainforest in the Gran Piedra. Structurally, it can be considered as a shrubby forest and / or a tree scrub. A low canopy layer is present in the most evolved part (fieria II), between 7 and 10 m height and with a slightly sparse to dense (80-100%) cover. In the group of accompanying species, barril and clavellina (*Lyonia latifolia* subsp. *calycosa*) are subdominants, while in the group of aggregated species, arraigán (*Myrica cerifera*) is. In the shrub layer, with a cover from media to very high (40-100%) camaguilla is subdominant and *Citharexylum* sp., yaicuaje, yareicillo, vigueta (*Guettarda valenzuelana*) and uverillo (*Coccoloba wrightii*) are aggregated. In the herbaceous layer, with a cover of high to very high (80-100%) are dominguito, palma boba, yareicillo, toad, yaicuaje, *Eugenia scaphophylla*, copey, boniatillo, guáran, canelón and camaguilla. The other species of the shrub and herbaceous layers, ferns, lianas and epiphytes are in the Table 28.

Oecotope characteristics. This community was studied in the highest parts of Sierra de la Gran Piedra, above 1000 m asl; inclination is variable, usually greater than 20 degrees, the exposure is diverse and the microrelief is regular. Weather conditions are avoided, as they are described in palma boba with dominguito.

Soil is leachate red ferralitic (Hernández & al., 1994), poor and acid, usually deep, moderately fertile (B) and fresh (2), so its potential productive capacity is regular (III). Withered leaves are well developed. The L layer varies between 1.5 and 4 cm, mostly between 2 and 2.5 cm, while the F layer fluctuates between 1 and 2 cm, exceptionally more. The H layer forms a root mat embedded in a matrix of humus. It is greater than 10 cm in the most advanced areas and little in smaller areas. At

this successional stage, such root mat is the main element in the recirculation of nutrients in this ecosystem. Decomposition is very slow since plants that provide 75% or more of the observed withered leaves [copey, yareicillo, yaicuje, clavellina, fern (*Cyathea parvula*) and sometimes, tapa camino (*Palicourea alpina*) and aguacatillo] mainly provide a sclerophyllous material. The typology classification is as follows B2, 7a<sub>e</sub>, III, Rm\*\*, M.f., C.t.

Distribution. It locates in the top of Sierra de la Gran Piedra, up 1000 m asl.

Forest management. It must be protected from any human intervention as it is an early community (homeostasis I and early fieria II) from the mountain rainforest, typical of the place, and there are only isolated remnants.

**Pomarrosa with palma boba (*Syzygium jambos* with *Prestoea acuminata* var. *montana*)**

Physiognomy and floristic composition. This secondary forest, consisting of a gallery forest or isolated forest fragments (2 plots), is observed in Sierra de la Gran Piedra, about 1000 m asl in oecotopes of mountain rainforest. The canopy layer covers 100% of the area (dense coverage) and is from 12 to 15 m high. Pomarrosa (D, A-C 5) is observed as main species and copey (I, A-C 1) as subdominant. The shrub layer is variable, between 20 and 80% (medium coverage). Dominguito (A-C 2) and palma boba (A-C 2) are abundant. The herbaceous layer is dense, 80 to 100% with a diverse composition.

Ecology and distribution. Soils are shallow and with relatively plastic clay, which favors moisture retention; exposures are to the north and the inclination is 15 to 20 degrees. Weather conditions are avoided as they are described in dominguito with palma boba. The typology classification is considered as B2-3, 7a<sub>e</sub>, II-III, S.j., P.a.

Forest management. Pomarrosa gallery forests exceptionally protect the banks of streams and rivers, so its replacement must be gradual, in small areas, and only continue it after the treated area is consolidated. Dominguito, moruro rojo, *Tabebuia* spp., yaicuaje, palma boba, guáran, ramón cow and aguacatillo can be used as alternative species. Planting should be dense in order to achieve rapid coverage. The areas where forests are stable must be also partially substituted, by group, with species typical of mountain rainforest, including: purio fangar, yaicuaje, toad, aguacate cimarrón, barril, boniatillo, cuajaní, aguacatillo, roble de olor, ayúa, jubilla, macagua, etc.

**Purio fangar with marañón de la maestra (*Guatteria neglecta* with *Magnolia cubensis*; Table 29)**

Physiognomy and floristic composition. This is a very complex type of forest, since they are late and mature communities of this mountain rainforest. It usually has between 39 and 53 species per inventory (species average of 48.6).

In its mature stage, it usually has a canopy layer between 18 and 20 m high, often up to 25 m or showing emerging until that point. Coverage is dense (typically 100%). In the group of constant species, marañón de la maestra (*Magnolia cubensis* subsp. *cubensis*), yaicuaje, dominguito, purio fangar, toad, lengua de vaca (*Ixora ferrea*), aguacate cimarrón (*Persea anomala*), camaguilla, cletra, cordobán (*Miconia pteroclada*) and *Viburnum villosum* are main species. In the group of accompanying species, boniatillo, copecillo (*Clusia grisebachiana*), cuajaní and ramon cow are subdominant species in this stratum; while barril, aguacatillo and roble de olor (*Tabebuia brooksiana*) are aggregated (Table 29). The shrub (thicket from medium to high, 40-70%) and herbaceous (medium to high, 40-80%) layers are rich in tree species.

Sometimes, pino de la maestra (*Pinus maestrensis*) forms successional stages (fiera II - homeostasis II) of this rainforest. In these places the pine tree forms a closed sub-layer of about 30 to 35 m tall. In addition, there is a second sub-layer between 10 and 16 m in height and of 50 to 60% coverage, exclusively composed by broadleaf from rainforests, where the most abundant species are dominguito (the most abundant), cordobán (*Miconia dodecandra*), cordobán (*M. pteroclada*), camaguilla, aguacatillo, boniatillo, lengua de vaca and brunelia.

In the successional stage homeostasis II, with exclusive participation of the broad-leaved species from the mountain rainforest, they form a dense canopy layer (100%) with a height between 15 and 18 m. Relict emergings are also seen of about 25 m. Although it is young, an ecosystem balance is observed in this stage, as there is stability in the species of this forest type. The most abundant species are dominguito, purio fangar, yaicuaje, barril, copecillo, boniatillo, aguacate cimarrón and other scattered species. At this stage there is a good development of the humus layers. The L layer is 3 cm, F is 1.5 cm and H layer constitutes a root mat embedded in a matrix of humus of about 3 cm.

Oecotope characteristics. It occupies the "floor of mountain rainforests", between 800

and 1400 m asl (low mountains), but it was mainly studied between 1200 and 1300 m asl. The predominant slopes vary between 20 and 45 degrees and exposures are varied, the microrelief is also diverse. The climate is tropical moist mountain (7a). Rainfall is around 2000 mm (rainy weather), with fog and low clouds (usually dense) most days of the year, resulting in high atmospheric humidity. Main data are similar to those from the oecotope of palma boba with dominguito.

It develops mainly in the Cobre Group rocks, mainly tuffs, andesites and granites. The soil is leachate red ferrallitic (Renda, 1989), often deep, very poor and acidic, moderately fertile (B) and fresh (2), so its potential productive capacity is regular (III). It has good internal and external drainage. The L layer is between 1.5 and 3 cm thick, while the F layer generally ranges from 2 to 2.5 cm. Root mat ranges from 6 to 13 cm, sometimes up to 20 cm in nanodepressions. The typology classification is considered as B2, 7a<sub>e</sub>, III, Rm\*\*\*\*, G.n., M.c.

Distribution. This type of forest grows in the highlands of Western Sierra Maestra.

Forest management. It must be protected from all human activity, even their successional stages, because due to its geomorphological position. Such position gives it a huge hydrological importance, and allows it to protect waters and an extremely erodible soil. Only controlled observation of its values and scientific research should be allowed. This should be prioritized especially in areas outside protected areas.

**Ferns with barril (*Cyathea furfuracea* and *C. parvula* with *Cyrilla silvae*)**

Initial forests that make up the ferns with barril are the successional stages homeostasis I and fieria II from the mountain rainforest in the Western Sierra Maestra. *Cyrilla silvae* and the tree ferns *Cyathea furfuracea* and *C. parvula* dominate the shrub-canopy layer. Each stage shows some structural and floristic differences, which allow separate studies, in two subtypes:

Ferns with barril,

Ferns with barril and yagruma macho.

Oecotope characteristics. It was studied between 1000 and 1400 m asl. The ecological conditions are shown in purio fangar with marañón de la maestra (*Guatteria neglecta* with *Magnolia cubensis*).

Table 29. Characteristic combination of purio fangar with marañón de la maestra (*Guatteria neglecta* with *Magnolia cubensis*, 9 plots)

| Species  | Vertical structure | Abundance-Coverage | Presence Degree |
|--|--------------------|--------------------|-----------------|
| Canopy layer   |                    |                    |                 |
| E <sub>3,2,1</sub> <i>Magnolia cubensis</i> subsp. <i>cubensis</i> | P                  | 1                  | V               |
| <i>Guatteria neglecta</i>  | D                  | 1                  | V               |
| <i>Matayba oppositifolia</i>                                       | D                  | 1                  | V               |
| <i>Chionanthus domingensis</i>                                     | D                  | 1                  | V               |
| <i>Ocotea leucoxydon</i>   | D                  | 1                  | V               |
| <i>Ixora ferrea</i>  | D                  | 1                  | V               |
| <i>Persea anomala</i>  | D                  | 1                  | V               |
| <i>Myrsine coriacea</i>  | I                  | 1                  | V               |
| <i>Clethra cubensis</i>  | I                  | 1                  | V               |
| E <sub>3,2</sub> <i>Miconia pteroclada</i>                         | I                  | 1                  | V               |
| <i>Viburnum villosum</i>   | I                  | 1                  | V               |
| E <sub>3,2,1</sub> <i>Dendropanax arboreus</i>                     | C                  | 1                  | IV              |
| <i>Cinnamomum elongatum</i>  | C                  | 1                  | IV              |
| <i>Prunus occidentalis</i>   | C                  | 1                  | IV              |
| E <sub>3,1</sub> <i>Clusia grisebachiana</i>                       | I                  | 1                  | IV              |
| E <sub>3,2,1</sub> - <i>Cyrilla silvae</i>                         | C                  | 2                  | III             |
| E <sub>3,1</sub> <i>Alchornea latifolia</i>                        | C                  | 1                  | III             |
| E <sub>3,2</sub> <i>Tabebuia brooksiana</i>                        | I                  | 1                  | III             |
| Shrub layer  |                    |                    |                 |
| E <sub>2,1</sub> <i>Meriania leucantha</i> var. <i>nana</i>        | -                  | 1                  | V               |
| <i>Graffenrieda rufescens</i>                                      | -                  | 1                  | V               |
| <i>Palicourea alpina</i>   | -                  | 1                  | V               |
| <i>Psychotria grandis</i>  | -                  | 1                  | V               |
| <i>Eugenia laeteviridis</i>  | -                  | 1                  | V               |
| <i>Garrya fadyena</i>  | -                  | 1                  | III             |
| <i>Weinmannia pinnata</i>  | -                  | 1                  | III             |
| <i>Clidemia umbellata</i>  | -                  | 1                  | III             |
| Herbaceous layer   |                    |                    |                 |
| E <sub>1</sub> <i>Zeugites americana</i>                           | -                  | 1                  | V               |
| <i>Arthrostylidium multispicatum</i>                               | -                  | 1                  | V               |
| <i>Hedyosmum grisebachii</i>                                       | -                  | 1                  | III             |
| <i>Panicum glutinosum</i>  | -                  | 1                  | III             |
| <i>Peperomia maculosa</i>  | -                  | 2                  | III             |
| <i>Begonia cubensis</i>  | -                  | 1                  | III             |
| Ferns  |                    |                    |                 |
| E <sub>3</sub> - <i>Cyathea parvula</i>                            | I                  | 1                  | V               |
| E <sub>3,2</sub> <i>Cyathea furfuracea</i>                         | I                  | 1                  | IV              |
| E <sub>2</sub> - <i>Alsophylla major</i>                           | -                  | 1                  | V               |
| L- <i>Odontosoria aculeata</i>                                     | -                  | 1                  | IV              |
| Ep- <i>Hymenophyllum</i> sp.                                       | -                  | 1                  | IV              |
| <i>Polybotria osmundacea</i>                                       | -                  | 1                  | III             |
| <i>Campiloneurum angustifolium</i>                                 | -                  | 1                  | III             |
| <i>Polypodium loricum</i>  | -                  | 1                  | III             |
| Epiphytes  |                    |                    |                 |
| <i>Guzmania</i> sp.  | -                  | 1                  | V               |
| <i>Guzmania monostachya</i>  | -                  | 1                  | IV              |
| <i>Tillandsia fasciculata</i>                                      | -                  | 1                  | IV              |
| <i>Isochilos linearis</i>  | -                  | 1                  | IV              |

Scattered species in the canopy layer: *Ocotea spathulata*, macaguey (toad), yagruma, ayúa, macagua, yareicillo, *Sapium erythrospermum*, almendrillo, guárano, jubilla, cordobán (*Miconia dodecandra*), pino de la maestra, palma boba, brunelia, *Pimenta* sp., ramon horse, achotillo (*Hieronyma nipensis*), *Manilkara valenzuelana*, bone, jiquí (*Pera bumeliifolia*), *Ditta myricoides*, *Coccoloba* sp. and vigueta.

### Ferns with barril (*Cyathea furfuracea* and *C. parvula* with *Cyrilla silvae*; Table 30)

Physiognomy and floristic composition. As stage of homeostasis I in oecotopes of this mountain rainforest, barril and tree ferns *Cyathea parvula* and *C. furfuracea* dominate the shrub canopy layer, with a height between 5 and 8 m; occasionally reaching up to 12 m. They usually close the canopy, with 100% coverage and more (superdense). This creates umbrophylle conditions and the original forest species enter within them. They reach this layer or are already in the below ones. Likewise, the pioneer species: cucaracha (*Pteridium aquilinum* var. *arachnoideum*), *Dicranopteris pectinata*, malva blanca (*Urena*

*lobata*), rompezaraguey (*Chromolaena odorata*), etc, begin to disappear. In the group of constant species, barril, *Cyathea parvula* and *C. furfuracea* are main species. Lengua de vaca, camaguilla, copey, cletra and cordobán (*Miconia dodecandra*) are tree subdominant in shrub and herbaceous layers. Aguacatillo, brunelia, toad, marañón de la maestra and yaicua-je are aggregated. Other species are shown in Table 30.

Humus diversification is clearly observed at this stage; an L layer of 1.5 to 3 cm is presented, as well as an F layer of 0.5 to 1.5 cm. There are big differences in the H layer, from traces up to a well-developed root mat 10 cm thick.

Table 30. Characteristic combination of ferns with barril (*Cyathea parvula* and *C. furfuracea* with *Cyrilla silvae*, 7 plots)

| Species   | Vertical structure | Abundance-Coverage | Presence Degree |
|---|--------------------|--------------------|-----------------|
| Canopy layer                                    |                    |                    |                 |
| <i>Cyrilla silvae</i>                           | D                  | 3                  | V               |
| <i>Cyathea parvula</i>                          | D                  | 3                  | V               |
| <i>Cyathea furfuracea</i>                       | D                  | 2                  | V               |
| Shrub layer                                     |                    |                    |                 |
| <i>Ixora ferrea</i>                             | -                  | 1                  | V               |
| <i>Myrsine coriacea</i>                         | -                  | 1                  | V               |
| <i>Chromolaena</i> sp.                          | -                  | 1                  | V               |
| <i>Palicourea alpina</i>                        | -                  | 1                  | V               |
| Shrubs and herbaceous layers                    |                    |                    |                 |
| <i>Alchornea latifolia</i>                      | -                  | 1                  | III             |
| <i>Brunellia comocladifolia</i>                 | -                  | 1                  | III             |
| <i>Ocotea leucoxyton</i>                        | -                  | 1                  | III             |
| <i>Magnolia cubensis</i> subsp. <i>cubensis</i> | -                  | 1                  | III             |
| <i>Ossaea granulata</i>                         | -                  | 1                  | III             |
| <i>Mataybe oppositifolia</i>                    | -                  | 1                  | III             |
| <i>Viburnum villosum</i>                        | -                  | 1                  | III             |
| Herbaceous layer                                |                    |                    |                 |
| <i>Clidemia umbellata</i>                       | -                  | 1                  | V               |
| <i>Clusia grisebachiana</i>                     | -                  | 1                  | IV              |
| <i>Clethra cubensis</i>                         | -                  | 1                  | IV              |
| <i>Miconia dodecandra</i>                       | -                  | 1                  | IV              |
| <i>Panicum glutinosum</i>                       | -                  | 1                  | IV              |
| <i>Coccocypselum lanceolatum</i>                | -                  | 1                  | IV              |
| <i>Zeugites americana</i>                       | -                  | 1                  | III             |
| <i>Scleria lithosperma</i>                      | -                  | 1                  | III             |
| Ferns   |                    |                    |                 |
| <i>Hypolepis nigrescens</i>                     | -                  | 1                  | IV              |
| <i>Sticherus bifidus</i>                        | -                  | 1                  | III             |
| <i>Dicranopteris pectinata</i>                  | -                  | 1                  | III             |
| Epiphytes                                       |                    |                    |                 |
| <i>Guzmania monostachya</i>                     | -                  | 1                  | III             |

Scattered species in the canopy layer: roble de olor, cordobán (*Miconia pteroclada*), *Eugenia laeteviridis*, jubilla.



**Ferns with barril and yagruma macho (*Cyathea furfuracea* and *C. parvula* with *Cyrilla silvae* and *Schefflera morototoni*; Table 31)**

As it is known, the fiera II phase begins when tree species surpass the homeostasis I stratum, and competitively interact among them.

They form a canopy layer of 8 to 12 m, with isolated individuals of 15 m and coverage from sparse to dense (50-100%). barril, cordobán (*Miconia dodecandra*) and the *Cyathea furfuracea* and *C. parvula* ferns are in the

group of constant species from the tree and shrub layers. Brunelia, aguacatillo, camaguilla are subdominant, as well as lengua de vaca and toad in the shrub layer. In the group of accompanying species, copecillo is subdominant and yagruma macho (*Schefflera morototoni*), cletra, cordobán (*Miconia pteroclada*), marañon de la maestra and *Eugenia laeteviridis* are aggregated species.

The shrub and herbaceous layers have a high density, 60 to 90% and 50 to 70%, respectively, with various tree sprouts. Other species are found in Table 31.

Table 31. Ferns with barril and yagruma macho (*Cyathea furfuracea* and *C. parvula* with *Cyrilla silvae* and *Schefflera morototoni*, 7 plots)

| Species   | Vertical structure | Abundance-Coverage | Presence Degree |
|---|--------------------|--------------------|-----------------|
| Canopy and shrub layers   |                    |                    |                 |
| <i>Cyrilla silvae</i>   | D                  | 3                  | V               |
| <i>Miconia dodecandra</i>   | D                  | 2                  | V               |
| <i>Cyathea furfuracea</i>   | D                  | 2                  | V               |
| <i>Cyathea parvula</i>  | D                  | 2                  | V               |
| <i>Brunellia comocladifolia</i>                                   | C                  | 1                  | V               |
| <i>Alchornea latifolia</i>  | C                  | 1                  | V               |
| <i>Myrsine coriacea</i>   | C                  | 1                  | V               |
| <i>Clethra cubensis</i>   | I                  | 1                  | III             |
| <i>Miconia pteroclada</i>   | I                  | 1                  | III             |
| Shrub layer   |                    |                    |                 |
| <i>Palicourea alpina</i>  | -                  | 2                  | V               |
| <i>Ixora ferrea</i>   | -                  | 1                  | V               |
| <i>Clidemia umbellata</i>   | -                  | 1                  | V               |
| <i>Ocotea leucoxylon</i>  | -                  | 1                  | V               |
| <i>Clusia grisebachiana</i>                                       | -                  | 1                  | IV              |
| <i>Chromolaena</i> sp.  | -                  | 1                  | IV              |
| <i>Magnolia cubensis</i> subsp. <i>cubensis</i>                   | -                  | 1                  | III             |
| Herbaceous layer  |                    |                    |                 |
| <i>Panicum glutinosum</i>   | -                  | 1                  | V               |
| <i>Coccocypselum herbaceum</i>                                    | -                  | 1                  | IV              |
| <i>Eugenia laeteviridis</i>                                       | -                  | 1                  | III             |
| <i>Scleria lithosperma</i>  | -                  | 1                  | III             |
| Ferns   |                    |                    |                 |
| <i>Hypolepis nigrescens</i>                                       | -                  | 1                  | V               |
| <i>Sticherus bifidus</i>  | -                  | 1                  | III             |
| <i>Dicranopteris pectinata</i>                                    | -                  | 1                  | III             |
| Epiphytes   |                    |                    |                 |
| <i>Guzmania monostachya</i>                                       | -                  | 1                  | III             |
| Differential combination from ferns with barril and yagruma macho |                    |                    |                 |
| <i>Arthrostylidium multispicatum</i>                              | -                  | 1                  | .V              |
| <i>Passiflora sexflora</i>  | -                  | 1                  | V               |
| <i>Blechnum fragile</i>   | -                  | 1                  | V               |
| <i>Schefflera morototoni</i>                                      | C                  | 1                  | III             |
| <i>Callicarpa ferruginea</i>                                      | -                  | 1                  | III             |
| <i>Oplismenus setarius</i>  | -                  | 1                  | III             |
| <i>Alsophylla major</i>   | -                  | 1                  | III             |
| <i>Odontosoria jenmanii</i>                                       | -                  | 1                  | III             |
| <i>Elaphoglossum chartaceum</i>                                   | -                  | 1                  | III             |

Scattered species in the canopy layer: yaicuaje, canelón, roble de olor, oreganillo (*Weinmannia pinnata*), dominguito and ramon cow.

### **Barril with marañon de la maestra (*Cyrilla silvae* with *Magnolia cubensis*; Table 32)**

Physiognomy and floristic composition. As zonal formation it is a cloud forest (Samek, 1975; Reyes, 2006, 2011-2012), also known as fresh forest (León, 1946; Samek, 1974) and elfin forest (Borhidi, 1996). In this forest, the canopy layer with 10 to 15 m in height is dense (80-100%). Barril and marañon de la maestra are main species and the most abundant in the group of constant species. Cletra is subdominant in the group of accompanying species, while *Henriettea ekmanii* is aggregated. Other species from the shrub (media to high coverage, 40-70%) and herbaceous (high, 50-80%) layers are found in Table 32.

Oecotope characteristics. It usually occurs in steep topographic positions, mostly between 40 and 45 degrees (Reyes & Acosta, 2005) and with various exposures. In the range of altitudinal variation of this type of forest, the average temperatures at 1 500 m a.s.l vary between 15.2 °C in the north slope and 15.5 °C on the south side. It can also reach around 13 °C at 1972 m asl (Montenegro, 1991b). Although there are not direct measurements in the area occupied by this forest, it falls around 2 000 mm of rain. The wettest period is from april or may to october and the less rainy period is from november to march or april (Trusov & al., 1983). The mean annual relative humidity is between 85 and 90% (Montenegro, 1991c). Orographic clouds or mists occur almost every day of the year, and along with the rain, they bring lots of moisture into the forest (even in the dry season), the climate is high mountain tropical (7b).

From the geological point of view it occupies rocks from the Cobre Group, tuffs, tuffaceous sandstones, etc. (Méndez & al., 1994). The predominant soil is leached yellow ferrallitic, which dominates above 1500 m asl According to Renda & al. (1981b) and Renda (1989), the pH in the upper horizons is from acid to very acidic and it reaches values of 4.45 to 5.3 in water, and 3.5 to 4.15 in CIK. The assimilable nitrogen varies from 0.80 to 11.08 mg/100 g and tends to sharply decrease in depth. Phosphorus is absent or in traces; assimilable potassium fluctuates between 3.0 and 10 mg/100 g. The CCB (S value) is very

low, generally ranging between 1.44 and 5.02 cmol (+).kg<sup>-1</sup>. CIC (T value) is from 2.5 to 18.75 cmol (+).kg<sup>-1</sup>. This shows the low degree of saturation and that the complex has little cation due to intense weathering process. Therefore, this edatope should be regarded as little fertile (A), fresh (2) and with a potential productive capacity bad (IV).

A distinctive feature of this forest is its well-defined humus layers (sensu Herrera & Rodríguez, 1988). The L layer reaches about 2 cm, occasionally more or less; F layer fluctuates between 1 and 2 cm, and H layer is a well-developed root mat embedded in a matrix of humus, where the fine roots and rootlets are, and in which the nutrient cycle of this conspicuous ecosystem occurs (Reyes & al., 2011). This means, that this poor, acidic soil, is only used for plant fixation (thick roots) and virtually does not take part in their energy source.

The typology classifications is considered as A2, 7b<sub>e</sub>, IV, Rm\*\*, C.s., M.c.

Distribution. This cloud forest develops in the highest parts of Western Sierra Maestra, from about 1 500 m above sea level to the top of Pico Real del Turquino. Its greatest extent is observed in the massifs of Turquino and La Maestrica de los Libertadores – La Bayamesa. In other places, there are only isolated fragments.

Forest management. Because of the ecology conditions (Reyes & Fornaris, 2011), the vegetation growth is extremely slow and trees have small thicket and size. Due to its topographic and geomorphologic position, the highest value of this type of forest is the protection of soil and water. That is why; it must be preserved against all forms of human intervention. An area from high La Bayamesa (1572 m asl) was studied. This area was deforested in 1962 due to the triangulation of Sierra Maestra. Forty five years later, regeneration have not exceed three meters, so it is considered that its recovery to mature forest can last from 150 to 200 years; even the restoration of the root mat (basis for its nutrient cycling) is exceptionally slow. Its protecting value widely exceeds the one it may have as wood producer; therefore only controlled observation and scientific research should be allowed.

Table 32. Characteristic combination of barril with marañón de la maestra  
(*Cyrilla silvae* with *Magnolia cubensis*, 6 plots)

| Species   | Vertical structure | Abundance-Coverage | Presence Degree |
|---|--------------------|--------------------|-----------------|
| Canopy layer  |                    |                    |                 |
| <i>Cyrilla silvae</i>                               | D                  | 3                  | V               |
| <i>Magnolia cubensis</i> subsp. <i>cubensis</i>     | D                  | 2                  | V               |
| <i>Clusia grisebachiana</i>                         | C                  | 1                  | V               |
| <i>Ditta myricoides</i>                             | C                  | 1                  | V               |
| <i>Ixora ferrea</i>                                 | C                  | 1                  | V               |
| <i>Chionanthus domingensis</i>                      | C                  | 1                  | V               |
| <i>Weinmannia pinnata</i>                           | C                  | 1                  | V               |
| <i>Brunellia comocladifolia</i>                     | I                  | 1                  | V               |
| <i>Myrsine coriacea</i>                             | I                  | 1                  | V               |
| <i>Clethra cubensis</i>                             | I                  | 1                  | IV              |
| <i>Henriettea ekmanii</i>                           | I                  | 1                  | III             |
| Shrub layer   |                    |                    |                 |
| <i>Graffenrieda rufescens</i>                       | -                  | 3                  | V               |
| <i>Purdiaea stenopetala</i> var. <i>stenopetala</i> | -                  | 1                  | V               |
| <i>Palicourea alpina</i>                            | -                  | 1                  | V               |
| <i>Ilex macfadyenii</i>                             | -                  | 1                  | V               |
| <i>Viburnum villosum</i>                            | -                  | 1                  | V               |
| <i>Lyonia elliptica</i>                             | -                  | 1                  | V               |
| <i>Eugenia laeteviridis</i>                         | -                  | 1                  | V               |
| <i>Guapira obtusata</i>                             | -                  | 1                  | IV              |
| Herbaceous layer                                    |                    |                    |                 |
| <i>Hedyosmum grisebachii</i>                        | -                  | 1                  | V               |
| <i>Lisianthus glandulosus</i>                       | -                  | 1                  | V               |
| <i>Scleria lithosperma</i>                          | -                  | 1                  | V               |
| <i>Zeugites americana</i>                           | -                  | 1                  | V               |
| <i>Ocotea spathulata</i>                            | -                  | 1                  | IV              |
| <i>Ilex</i> sp.                                     | -                  | 1                  | IV              |
| <i>Callicarpa ferruginea</i>                        | -                  | 1                  | IV              |
| <i>Sapium erythrospermum</i>                        | -                  | 1                  | III             |
| <i>Phaius tankervilleae</i>                         | -                  | 1                  | III             |
| <i>Peperomia tenella</i>                            | -                  | 1                  | III             |
| Ferns   |                    |                    |                 |
| <i>Alsophylla major</i>                             | -                  | 1                  | V               |
| <i>Cyathea parvula</i>                              | -                  | 1                  | V               |
| <i>Odontosoria scandens</i>                         | -                  | 1                  | V               |
| <i>Sticherus bifidus</i>                            | -                  | 1                  | V               |
| <i>Trichomanes robustum</i>                         | -                  | 1                  | V               |
| <i>Cyathea furfuracea</i>                           | I                  | 1                  | IV              |
| <i>Elaphoglossum chartaceum</i>                     | -                  | 1                  | IV              |
| <i>Campiloneurum phyllitidis</i>                    | -                  | 1                  | III             |
| <i>Politrichum</i> sp.                              | -                  | 1                  | III             |
| <i>Polybotria osmundacea</i>                        | -                  | 1                  | III             |
| Epiphytes   |                    |                    |                 |
| <i>Isochilus linearis</i>                           | -                  | 1                  | V               |
| <i>Catopsis</i> cf. <i>floribunda</i>               | -                  | 1                  | IV              |

Scattered species in the canopy layer: *Guatteria moralesii*, macurije, cordobán (*Miconia dodecandra*), pino de la maestra and *Wallenia* sp.

Localities: highest altitudes of Sierra Maestra.

## Conclusions

Thirty five broadleaf forest types and / or subtypes were studied. The forest types and / or subtypes more abundant are those belonging to the semideciduous microphyll forest (12), followed by the mangroves and mountain rainforest with an equal amount (7).

The 27 forest types and / or subtypes without marine influence, with coastal and low altitude, 63%, have a potential productive capacity (PPC) going from bad (44.4%) to very bad (18.5%), because the erosion decrease the effective deep and increased the stony in the soil horizon. The regular PPC (III) is prevailing in the mittel and mountain zone because of the great profundity of soil. In the highest forest type the PPC decrease again owing to the poorest T and S value.

In its characteristic combination the primary forests types there are richest in tree species (18.4) than the secondary (8.4); outstanding for its richness the presents from 500 to 800

m asl, and for poorness those closed to marine influence. It's outstanding that, the primary montane types are lianas poorest and epiphytes and ferns are richest than the types at low altitude. Forest types above 800 m asl and mangroves are protection forests.

The tropical climate with 5 to 6 months little rainy (4bTh) is the most prevalent in Sierra Maestra.

## Acknowledgments

Most of the samples were taken within the framework of two projects: "Biological diversity of Sierra Maestra and Nipe Sagua Baracoa mountain ranges" and "Environmental educational initiatives to encourage sustainable local development in protected areas of rainforests of the Eastern Cuban Region". Translation to English was made by Haydee Noemi Vidal Carrillo. We highly value your support.

## References

- Álvarez, P.A. & Varona, J.O. 1988. *Silvicultura*. Ed. Pueblo y Educación, La Habana. 354 pp.
- Álvarez, A.F., Mercadet, A. 2012. *El sector forestal cubano y el cambio climático*. Inst. Inv. Agr.-For. Min. Agric., La Habana. 248 pp.
- Bisse, J. 1988. *Árboles de Cuba*.— Ed. Científico Técnica, La Habana. 384 pp.
- Borhidi, A. 1991. *Phytogeography and Vegetation Ecology of Cuba*. Akad. Kiadó. Budapest. 857 pp.
- Borhidi, A. 1996. *Phytogeography and Vegetation Ecology of Cuba*. 2 Ed. Akad. Kiadó. Budapest. 926 pp.
- Boytel Yambú, F. 1972. *Geografía eólica de Oriente*. Inst. Cubano del Libro. 251 pp.
- Braun-Blanquet, J. 1979. *Fitosociología. Bases para el estudio de las comunidades vegetales*. H. Blume ediciones, 820 pp. Madrid.
- Budowski, G. 1985. *La conservación como instrumento para el desarrollo*. Ed. Univers. Estatal a Distancia. San José, Costa Rica. 398 pp.
- Capote, R.P., Menéndez, L., García, E.E. & Herrera, R.A. 1988. *Sucesión Vegetal*. In: Herrera, R.A., Menéndez, L., Rodríguez, M.A., García, E.E. (Eds.) *Ecología de los bosques siempreverdes de la Sierra del Rosario, Cuba*. Montevideo. ROSTLAC. Pp. 272–295.
- CITMA (Ministerio de Ciencia, Tecnología y Medio Ambiente). 2014. *V Informe Nacional al Convenio sobre la Diversidad Biológica*. La Habana. 253 pp.
- Comisión Cubano Hungara. 1976. *Mapa geológico 1:100 000*. Acad. Ci. Cuba, Acad. Ci. Hungary.
- Crespo, S.E. 1989. *Evaporación media anual*. In: *Nuevo Atlas Nacional de Cuba*. Mapa 42. Pp. VI.4.1.
- Del Risco, E. 2000a. *Metodología para la tipificación de los bosques cubanos*. Inst. Inv. For. (inéd). 29 pp.
- Del Risco, E. 2000b. *Tipología forestal*. Curso Postgrado. Univ. Pinar del Río. 74 pp + 3 anexos.
- Del Risco, E. & Samek, V. 1984. *Estudio fitocenológico de los pinares de Pinar del Río y su importancia práctica para la silvicultura*. Act. Bot. Cub. 29: 19-28.
- Gagua, G., Zarembo, A. & Izquierdo, A. 1989. *Precipitación media anual. 1931-1972*. In: *Nuevo Atlas Nacional de Cuba*. Pp. VI.3.1, mapa 24.
- Hernández, A., Pérez Jiménez, J.M., Bosh, D. & Rivero, L. 1994. *Nueva Versión de Clasificación Genética de los Suelos de Cuba*. Inst. Suelos, MINAG, La Habana. 66 pp.
- Herrera, R.A. & Rodríguez, M.E. 1988. *Clasificación funcional de los bosques tropicales*. In: Herrera, R.A., Menéndez, L., Rodríguez, M.A., García, E.E. (Eds.). *Ecología de los bosques siempreverdes de la Sierra del Rosario, Cuba*. Pp. 574-626. ROSTLAC, Montevideo.
- Kopp, D. 1965. *Richtlinie zur Standortsbeschreibung*. Posdam Forst. Inst.
- Lapinel, B. 1989. *Temperatura media anual del aire*. In: *Nuevo Atlas Nacional de Cuba*. Mapa 15. pp. VI.2.4.

- León (Hno.). 1946. Flora de Cuba. Vol. 1.. Contr. Ocas. Mus. Hist. Nat. del Colegio de la Salle Nr. 8, Habana. 441 pp.
- Méndez, I., Rodríguez, R., Rodríguez, E., Fernández, A., Rodríguez, M. 1994. Atlas de rocas de la Sierra Maestra. Emp. Geomínera de Oriente. 125 pp.
- Montenegro, U. 1990. Informe con los datos climáticos de la Gran Piedra. Dpto. Meteorología de Santiago de Cuba. Academia de Ciencias de Cuba.
- Montenegro, U. 1991a. Precipitación media anual. In: Atlas de Santiago de Cuba. Academia de Ciencias de Cuba, Santiago de Cuba. Mapa 33.
- Montenegro, U. 1991b. Temperatura media anual. In: Atlas de Santiago de Cuba. Academia de Ciencias de Cuba, Santiago de Cuba. Mapa 26.
- Montenegro, U. 1991c. Humedad relativa media anual. In: Atlas de Santiago de Cuba. Academia de Ciencias de Cuba, Santiago de Cuba. Mapa 28.
- Montenegro, U. 1991d. Evaporación media anual. In: Atlas de Santiago de Cuba. Academia de Ciencias de Cuba, Santiago de Cuba. Mapa 31.
- Montenegro, U. 1991e. Insolación media periodo lluvioso. In: Atlas de Santiago de Cuba. Academia de Ciencias de Cuba, Santiago de Cuba. Mapa 25.
- Núñez Jiménez, A & Viña Bayés, N. 1989. Regiones Naturales y Antrópicas. In: Nuevo Atlas Nacional de Cuba. pp. XII.2.1.
- Parada, M.E. & Torranzo, A.V. 2014. Ordenamiento forestal ambiental. Estudio de caso: cuenca embalse La Coca. *Agric. Org.* 20(2): 29-33.
- Regal García, A. 1988. Estudio de las precipitaciones en la región Sur-oriental de Cuba. La Habana. Tes. Dipl. (inéd.). Fac. Geografía. Univ. Habana. 45 pp.
- Renda, A. 1989. Particularidades edafológica-forestales de la región central de la Sierra Maestra. *Mem. Doc. (inéd.). Ci. Agric. ISCA Habana, La Habana.* 27 pp.
- Renda, A., Calzadilla, E., Bouza, J.A., Arias, J., Valle, M. & Pérez, N. 1980. Estudio edafológico, fisiográfico y agrisilvicultural de la Sierra Maestra, municipio Buey Arriba. MINAGRI, Centr. Inv. For., La Habana. 96 pp.
- Renda, A., Calzadilla, E., Bouza, J.A. & Valle, M. 1980-1981. Estudio sobre las condiciones edafológicas, fisiográficas y agrisilviculturales de la Sierra Maestra, Provincia Santiago de Cuba. MINAGRI, Centr. Inv. For., La Habana. 95 pp.
- Renda, A., Calzadilla, E., Bouza J.A., Arias, J., Valle, M. & Pérez, N. 1981a. Estudio edafológico – forestal y fisiográfico de la Sierra Maestra, municipio Bartolomé Masó. MINAGRI, Centr. Inv. For., La Habana. 123 pp.
- Renda, A., Calzadilla, E., Bouza, J.A., Arias, J. & Valle, M. 1981b. Estudio edafológico, fisiográfico y agrisilvicultural de la Sierra Maestra, municipio Guisa. MINAGRI, Centr. Inv. For., La Habana. 90 pp.
- Renda, A., Calzadilla, E., Bouza, J.A., Arias, J., Valle, M. & Pérez, N. 1981c. Estudio edafológico, forestal y fisiográfico de la Sierra Maestra, municipio Niquero. MINAGRI, Centr. Inv. For., La Habana. 63 pp.
- Renda, A., Calzadilla, E., Bouza, J.A., Arias, J., Valle, M. & Pérez, N. 1982. Estudio edafológico, fisiográfico y agrisilvicultural de la Sierra Maestra, municipio Media Luna. MINAGRI, Centr. Inv. For., La Habana. 22 pp.
- Reyes, O.J. 2006. Clasificación de la vegetación de la Sierra Maestra. *Biodiversidad de Cuba Oriental*, Vol. VIII. 28-42.
- Reyes, O.J. 2011-2012. Clasificación de la vegetación de la Región Oriental de Cuba. *Rev. Jard. Bot. Nal.* 32-33: 59-71.
- Reyes, O.J. & Acosta Cantillo, F. 2003. Fitocenosis presentes en las áreas costeras del Sur de la Sierra Maestra. I. Comunidades con influencia marina. *Foresta Veracruzana* 5(2): 1-8.
- Reyes, O.J. & Acosta Cantillo, F. 2004. Fitocenosis presentes en las áreas costeras del sur de la Sierra Maestra. II. Órdenes Varronio-Phyllostyletalia y Rhytidophyllo-Plumerietalia. *Foresta Veracruzana* 6(1): 37-43.
- Reyes, O.J., Martínez Quesada, E. & Acosta Cantillo, F. 2004a. Comunidades secundarias de la Región Oriental de Cuba. I. Clase Bothriochloetea pertusae Reyes. *Biodiversidad de Cuba Oriental*, Vol.VII. pp. 92-102. Ed. Academia.
- Reyes, O.J., Acosta Cantillo, F. & Martínez Quesada, E. 2004b. Comunidades secundarias de la Región Oriental de Cuba. II. Clase Senno-Acacietea macracanthae Reyes. *Biodiversidad de Cuba Oriental*, Vol. VII. Pp. 102-115. Ed. Academia.
- Reyes, O.J. & Acosta Cantillo, F. 2005. Vegetación. Cuba: Parque Nacional La Bayamesa. In: Maceira, D., Fong, A., Alverson, W.S. & Wachter, T. (Eds.). *Rapid Biological Inventories* 13. Pp. 43-50 & Apénd. The Field Museum, Chicago.

- Reyes, O.J. & Martínez Quesada, E. 2005. Fitocenosis presentes en las áreas costeras del sur de la Sierra Maestra. IV. Asociaciones Colubrino ellipticae-Gymnanthetum lucidae y Eugenio-Dipholidetum salicifoliae. *Foresta Veracruzana* 7(1): 47-52.
- Reyes, O.J. & Fornaris Gómez, E. 2011. Características funcionales de los principales bosques de Cuba Oriental. *Polibotánica* 32: 89-105.
- Reyes, O.J., Portuondo, E., Vadel, E. & Fornaris, E. 2011. Características fisonómicas y funcionales del bosque nublado de la Sierra Maestra. *Moscosa* 17: 139-149.
- Russó Milhet, I. 2015. La política forestal en Cuba. *Agric. Org.* 21(1): 6-7.
- Samek, V. 1973. Pinares de la Sierra de Nipe; Estudio Sinecológico. *Acad. Ci. Cuba, Ser. Forestal* 14, La Habana. 58 pp.
- Samek, V. 1974. Elementos de silvicultura de los bosques latifolios. *Inst. Cub. Libro, Ci. Téc., La Habana.* 291 pp.
- Samek, V. 1975. Hohenstufengliederung der Sierra Maestra (Kuba) und die Vegetation der supramontanen Stufe. *Arch. Bereich Waldbau Forstschutz, TU Dresden.*
- Samek, V. & Travieso, A. 1968. Climaregiones de Cuba. *Rev. Agric.* 2: 5-23.
- Schwanecke, W. 1970. Richtlinie für die Bildung und Kartierung der Standortseihen im Hügelland und Mittelgebirge der DDR. Postdam, VEB Forstprojektierung.
- Thomasius, H. 1965. Über einige Besonderheiten der forstlichen Standortserkundung und -kartierung in den Tropen. *Wiss. Zeitschrift TU Dresden* 14: 753-768.
- Trusov, I.I., Izquierdo, A. & Díaz, L.R. 1983. Características espaciales y temporales de las precipitaciones atmosféricas en Cuba. *Inst. Geogr. Acad. Ci. Cuba, La Habana.* 150 pp + 10 maps.
- Vilamajó, D., Capote, R.P., Fernández, M., Zamora, I. & González, B. 1989. Mapa bioclimático de Cuba. In: *Nuevo Atlas Nacional de Cuba. Inst. Geografía e ICGC.* pp. X.
- Viña Bayés, N. 1991. Carso. In: *Atlas de Santiago de Cuba. Mapa 22. Acad. Ci. Cuba, Santiago de Cuba.*

Appendix 1. Scientific names (genus, specie and author) and common names from species used in the tables 1-32.

| Scientific names   | Common names         |
|--|----------------------|
| <i>Abarema glauca</i> (Urb.) Barneby & J.W. Grimes       | abey                 |
| <i>Abrus precatorius</i> L.                              | peonía               |
| <i>Abutilon</i> sp.                                      | -                    |
| <i>Acacia macracantha</i> H. & B. ex Willd.              | guatapaná            |
| <i>Acrostichum danaefolium</i> Lang. & Fisch             | acróstico            |
| <i>Adelia ricinella</i> L.                               | jía blanca           |
| <i>Adiantum trapeziforme</i> L.                          | culantrillo de monte |
| <i>Agave underwoodii</i> Trelease                        | maguey               |
| <i>Agave</i> sp.   | maguey               |
| <i>Alchornea latifolia</i> Sw.                           | aguacatillo          |
| <i>Allophyllus cominia</i> (L.) Sw.                      | palo de caja         |
| <i>Alsophylla major</i> Caluff & Shelton                 | -                    |
| <i>Alternanthera maritima</i> (Mart.) Standl.            | -                    |
| <i>Alvaradoa amorphoides</i> Lieb.                       | aroma blanca         |
| <i>Alvaradoa arborescens</i> Griseb.                     | carmín               |
| <i>Amyris elemifera</i> L.                               | cuabilla, .cuaba     |
| <i>Anthirea radiata</i> (Griseb.) Urb.                   | vera                 |
| <i>Anthurium cubense</i> Engler                          | anturio              |
| <i>Aristolochia lindeniana</i> Duch.                     | -                    |
| <i>Arthrostylidium angustifolium</i> Nash                | tibisí               |
| <i>Arthrostylidium multispicatum</i> Pilger              | tibisí               |
| <i>Auerodendron cubensis</i> Britt. & Wils.              | cocuyo de costa      |
| <i>Avicennia germinans</i> (L.) L.                       | black mangrove       |
| <i>Bacopa monnieri</i> (L.) Pennull var. <i>monnieri</i> | verdolaga de costa   |
| <i>Begonia cubensis</i> Hassk.                           | begonia              |
| <i>Beilschmiedia pendula</i> (Sw.) Benth. & Hook.        | aceitunillo          |
| <i>Bidens pilosa</i> L.                                  | romerillo            |
| <i>Blechnum fragile</i> (Liebm.) Morton & Lellinger      | -                    |
| <i>Blechnum occidentale</i> L.                           | -                    |
| <i>Bothriochloa pertusa</i> (L.) A. Camus                | camagueyana          |
| <i>Bourreria setoso-hispida</i> O.E. Schulz              | -                    |
| <i>Bourreria virgata</i> (Sw.) G. Don                    | cafecillo            |
| <i>Bourreria</i> sp.                                     | -                    |
| <i>Brunellia comocladifolia</i> Bonpl.                   | brunelia             |
| <i>Bursera simaruba</i> (L.) Sargent.                    | almácigo             |
| <i>Caesalpinia vesicaria</i> L.                          | brasil               |
| <i>Callicarpa oblanceolata</i> Urb.                      | filigrana            |
| <i>Calophyllum antillanum</i> Britt.                     | ocuje                |
| <i>Calyptronoma plumeriana</i> (Martius) Lourtier        | manaca               |
| <i>Campiloneurum angustifolium</i> (Sw.) Fée             | -                    |
| <i>Campyloneurum phyllitidis</i> (L.) C. Presl           | pasa de negro        |
| <i>Canella winterana</i> (L.) Gaertn.                    | cúrbana              |
| <i>Capparis cynophallophora</i> L.                       | aceitunillo          |
| <i>Capparis flexuosa</i> L.                              | picha de perro       |
| <i>Capparis grisebachii</i> Eichl.                       | olivo                |
| <i>Capsicum frutescens</i> L.                            | ají gaguao           |
| <i>Carpodiptera cubensis</i> Griseb.                     | majaguilla           |
| <i>Casearia hirsuta</i> Sw.                              | raspalengua          |
| <i>Casearia sylvestris</i> Sw. var. <i>myricoides</i>    | sarnilla cimarrona   |
| <i>Casearia sylvestris</i> Sw. var. <i>sylvestris</i>    | aguedita dulce       |
| <i>Castela spinosa</i> Cronq.                            | abrojo de costa      |
| <i>Catopsis cf. floribunda</i> L. B. Sm.                 | curujey              |
| <i>Cecropia peltata</i> L.                               | yagruma              |
| <i>Cedrela cubensis</i> Bisse                            | red cedar            |
| <i>Cedrela odorata</i> L.                                | cedar                |

|   |                     |
|---|---------------------|
| <i>Celtis trinervia</i> Lam.                              | aguedita            |
| <i>Cenchrus ciliaris</i> L.                               | guizazo             |
| <i>Centrosema virginianum</i> (L.) Benth.                 | cricha de negra     |
| <i>Cinnamomum elongatum</i> (Nees) Kosterm.               | boniatillo          |
| <i>Cissampelos pareira</i> L.                             | bejuco prieto       |
| <i>Cissus trifoliata</i> L.                               | bejuco uví          |
| <i>Cissus verticillata</i> (L.) D.H. Nicolson & C. Jarvis | bejuco uví          |
| <i>Citharexylum caudatum</i> L.                           | penda               |
| <i>Citharexylum</i> sp.                                   | -                   |
| <i>Clethra cubensis</i> A. Rich.                          | cletra              |
| <i>Clidemia umbellata</i> (Mill.) L.O. Wms.               | cordobán            |
| <i>Clusia rosea</i> Jacq.                                 | cupey               |
| <i>Clusia tetrastigma</i> Vesque                          | cupey               |
| <i>Coccocypselum lanceolatum</i> Aubl                     | -                   |
| <i>Coccoloba diversifolia</i> Jacq.                       | guayacanejo         |
| <i>Coccoloba uvifera</i> Jacq.                            | uva caleta          |
| <i>Coccoloba wrightii</i> Lindau                          | uverillo            |
| <i>Coccoloba</i> sp.                                      | -                   |
| <i>Coccothrinax elegans</i> Borhidi & Mz.                 | yuraguana           |
| <i>Coccothrinax fragans</i> Burret                        | yuraguana           |
| <i>Coccothrinax gundlachii</i> León                       | yuraguana           |
| <i>Coffea arabica</i> L.                                  | cafeto              |
| <i>Cojoba arborea</i> (L.) Britt. & Rose                  | moruro rojo         |
| <i>Colubrina elliptica</i> (Sw.) Brizicki & Stearn.       | carbonero           |
| <i>Columnea cubensis</i> (Urb.) Britt.                    | -                   |
| <i>Commelina elegans</i> K.                               | canutillo1          |
| <i>Commelina erecta</i> L.                                | canutillo           |
| <i>Commicarpus scandens</i> (L.) Standl.                  | bejuco de purgación |
| <i>Comocladia dentata</i> Jacq.                           | guao                |
| <i>Conocarpus erectus</i> L.                              | yana                |
| <i>Corchorus</i> sp.                                      | -                   |
| <i>Cordia alba</i> Jacq.                                  | uvita               |
| <i>Cordia collococca</i> L.                               | ateje               |
| <i>Cordia gerascanthus</i> L.                             | baria               |
| <i>Crossopetalum</i> sp.                                  | -                   |
| <i>Croton lucidus</i> L.                                  | cuaba de ingenio    |
| <i>Cupania americana</i> L.                               | guárano             |
| <i>Cupania glabra</i> L.                                  | guara               |
| <i>Cupania glabra</i> Sw. var. <i>glabra</i>              | guara               |
| <i>Cyathea aspera</i> (L.) Sw.                            | -                   |
| <i>Cyathea furfuracea</i> Baker                           | helecho             |
| <i>Cyathea parvula</i> (Jenm.) Domin                      | helecho             |
| <i>Cynanchum</i> sp.1                                     | -                   |
| <i>Cynanchum</i> sp.2                                     | -                   |
| <i>Cyperus alternifolius</i> L.                           | paraguita           |
| <i>Cyperus giganteus</i> Vahl                             | -                   |
| <i>Cyrilla silvae</i> Berazain                            | barril              |
| <i>Cyrtopodium punctatum</i> (L.) Ldl.                    | cañuela             |
| <i>Chaptalia</i> sp.                                      | -                   |
| <i>Chiococca alba</i> (L.) Hitchc.                        | bejuco de berraco.  |
| <i>Chionanthus domingensis</i> Lam.                       | dominguito          |
| <i>Chromolaena odorata</i> (L.) King & Robins.            | rompezaraguey       |
| <i>Chromolaena</i> sp.                                    | -                   |
| <i>Chrysophyllum oliviforme</i> L.                        | caimitillo          |
| <i>Dalechampia scandens</i> L.                            | -                   |
| <i>Davila rugosa</i> Poit.                                | bejuco colorado     |
| <i>Desmanthus virgatus</i> (L.) Willd.                    | adormidera          |
| <i>Desmodium incanum</i> DC.                              | amor seco           |



|  |                   |
|--|-------------------|
| <i>Desmodium</i> sp.   | -                 |
| <i>Dichaea hystricina</i> Rchb.                              | -                 |
| <i>Dicliptera vahliana</i> Nees                              | gallitos          |
| <i>Dicranopteris pectinata</i> (Willd.) Und.                 | pata de gallina   |
| <i>Diospyrus grisebachii</i> (Hiern.) Standl.                | black ebony       |
| <i>Diplazium</i> sp.   | -                 |
| <i>Distictis rhynchocarpa</i> Urb.                           | bejuco logarte    |
| <i>Ditta myricoides</i> Griseb.                              | -                 |
| <i>Drypetes alba</i> Poit.                                   | bone              |
| <i>Drypetes mucronata</i> Griseb.                            | chicharrón        |
| <i>Drypetes</i> sp.  | -                 |
| <i>Echites umbellata</i> Jacq.                               | huevo de gallo    |
| <i>Elaphoglossum chartaceum</i> (Baker ex Jenm.) C. Christ.  | -                 |
| <i>Eleocharis elegans</i> (K.) R. & S.                       | junco             |
| <i>Eleocharis mutata</i> (L.) R. & S.                        | junco             |
| <i>Encyclia</i> sp.  | -                 |
| <i>Epidendrum nocturnum</i> Jacq.                            | flor de san pedro |
| <i>Epidendrum pygmaeum</i> Hook.                             | -                 |
| <i>Erithalis fruticosa</i> L.                                | cuaba prieta      |
| <i>Erythroxylum areolatum</i> L.                             | arabo carbonero   |
| <i>Erythroxylum havanense</i> Jacq.                          | jibá              |
| <i>Erythroxylum rotundifolium</i> Lunan                      | yarúa de costa    |
| <i>Eugenia asperifolia</i> Berg.                             | guairaje          |
| <i>Eugenia axillaris</i> (Sw.) Willd.                        | guairaje          |
| <i>Eugenia floribunda</i> West.                              | mije              |
| <i>Eugenia maleolens</i> Poir.                               | guairaje          |
| <i>Eugenia scaphophylla</i> Wr.                              | -                 |
| <i>Eugenia</i> sp.   | guairaje          |
| <i>Eupatorium</i> sp.  | -                 |
| <i>Euphorbia heterophylla</i> L.                             | lechosa           |
| <i>Exostema caribaeum</i> (Jacq.) R. & S.                    | lirio santana     |
| <i>Exothea paniculata</i> Radlk.                             | yaicuaaje         |
| <i>Faramea occidentalis</i> (L.) A. Rich.                    | -                 |
| <i>Ficus laevigata</i> Vahl                                  | jaguey            |
| <i>Ficus membranacea</i> C. Wr.                              | jaguey macho      |
| <i>Ficus suffucans</i> Griseb.                               | jaguey            |
| <i>Galactia</i> sp.  | -                 |
| <i>Garrya fadyena</i> Hook.                                  | -                 |
| <i>Geoffroea inermis</i> Wr.                                 | yaba              |
| <i>Gesneria heterochroa</i> Urb.                             | -                 |
| <i>Gesneria viridiflora</i> (Dcne.) Kuntze.                  | -                 |
| <i>Gesneria</i> sp.  | -                 |
| <i>Gouania lupuloides</i> (L.) Urb.                          | jaboncillo        |
| <i>Graffenrieda rufescens</i> Britt. & Wils.                 | -                 |
| <i>Grisebachianthus plucheoides</i> (Griseb.) King & Robins. | -                 |
| <i>Guapira obtusata</i> (Jacq.) Little                       | macaguey (toad)   |
| <i>Guarea guidonia</i> (L.) Sleumer                          | yamagua           |
| <i>Guatteria neglecta</i> (Griseb.) P. Wils.                 | purio fangar      |
| <i>Guazuma ulmifolia</i> Lam.                                | guásima           |
| <i>Guettarda calyptata</i> A. Rich.                          | guayabillo        |
| <i>Guettarda elliptica</i> Sw.                               | ciguilla          |
| <i>Guettarda valenzuelana</i> A. Rich.                       | vigueta           |
| <i>Guettarda</i> sp.   | -                 |
| <i>Guzmania monostachya</i> (L.) Rusby ex Mez                | curujey           |
| <i>Guzmania</i> sp.  | curujey           |
| <i>Gymnanthes lucida</i> Sw.                                 | yaití             |
| <i>Harrisia eriophora</i> (Pfeiff.) Britt.                   | jijira            |
| <i>Hedyosmun grisebachii</i> Solms                           | -                 |

|  |                       |
|--|-----------------------|
| <i>Helicteres semitriloba</i> Bert.                                    | tapa culo             |
| <i>Helicteres</i> sp.  | -                     |
| <i>Heliotropium indicum</i> L.   | alacrancillo          |
| <i>Henriettea ekmanii</i> (Urb.) Alain                                 | -                     |
| <i>Hibiscus brasiliensis</i> L.  | palo peregrino        |
| <i>Hippocratea volubilis</i> L.  | bejuco de castaña     |
| <i>Hymenophyllum</i> sp.   | -                     |
| <i>Hyperbaena paucinervis</i> Urb.                                     | picha jutía           |
| <i>Hyperbaena</i> sp.  | -                     |
| <i>Hypolepis nigrescens</i> Hook.                                      | -                     |
| <i>Ichnanthus mayarensis</i> (Wr.) Hitchc.                             | -                     |
| <i>Ilex macfadyenii</i> (Walp.) Rehder                                 | acebo cubano          |
| <i>Ilex repanda</i> Griseb.  | vigueta naranjo       |
| <i>Ilex</i> sp.  | -                     |
| <i>Ipomoea alba</i> L.   | flor de Y             |
| <i>Ipomoea</i> sp.   | -                     |
| <i>Isidorea polyneura</i> (Urb.) Aiello.                               | -                     |
| <i>Isochilus linearis</i> (Jacq.) R. Br.                               | -                     |
| <i>Ixora ferrea</i> (Jacq.) Benth.                                     | lengua de vaca        |
| <i>Jatropha gossipifolia</i> L.  | frailecillo           |
| <i>Laguncularia racemosa</i> (L.) Gaertn.                              | white mangrove        |
| <i>Lantana camara</i> L.   | filigrana             |
| <i>Lantana montevidensis</i> (Spreng.) Briq.                           | filigrana cimarrona   |
| <i>Lantana reticulata</i> Pers.  | orégano cimarrón      |
| <i>Lasiacis divaricata</i> (L.) Hitchc.                                | tibisí chico          |
| <i>Leucaena leucocephala</i> (Lam.) De Wit                             | ipil ipil             |
| <i>Licaria jamaicensis</i> (Nees) Kost.                                | leviza                |
| <i>Lisianthus glandulosus</i> A. Rich.                                 | -                     |
| <i>Lithacne pauciflora</i> (Sw.) Beauv.                                | pito enano            |
| <i>Lonchocarpus blainii</i> Wr.  | guamá hediondo        |
| <i>Lonchocarpus domingensis</i> Urb.                                   | guamá                 |
| <i>Ludwigia erecta</i> (L.) H. Hara                                    | -                     |
| <i>Lygodium volubile</i> Sw.   | -                     |
| <i>Lyonia elliptica</i> (Small) Alain                                  | clavellina            |
| <i>Lyonia latifolia</i> (A. Rich.) Griseb. subsp. <i>calycosa</i>      | clavellina            |
| <i>Lysyloma sabcicu</i> Benth.   | sabicú                |
| <i>Magnolia cubensis</i> Urb. subsp. <i>cubensis</i>                   | marañón de la maestra |
| <i>Malpighia apiculata</i> Urb.  | -                     |
| <i>Malpighia cnide</i> Spreng.   | palo bronco           |
| <i>Malpighia suberosa</i> Small.                                       | palo bronco           |
| <i>Malvastrum corchorifolium</i> (Desv.) Britt.                        | -                     |
| <i>Matayba oppositifolia</i> (A. Rich.) Britt.                         | yaicuaje              |
| <i>Maytenus buxifolia</i> (A. Rich.) Griseb.                           | carne de vaca         |
| <i>Melicoccus bijugatus</i> Jacq.                                      | mamoncillo            |
| <i>Melochia nodiflora</i> Sw.  | malva colorada        |
| <i>Meriania leucantha</i> Sw. var. <i>nana</i> Triana                  | -                     |
| <i>Merrenia bisecta</i> (Jacq.) Hall f.                                | aguinaldo de almendra |
| <i>Miconia dodecandra</i> (Desv.) Cogn.                                | cordobán              |
| <i>Miconia pteroclada</i> Urb.   | cordobán              |
| <i>Mikania micrantha</i> K.  | guaco                 |
| <i>Morinda royoc</i> L.  | piñipiñi              |
| <i>Myrcia fenziiana</i> O. Berg. (= <i>Gomidesia lindeniana</i> Berg.) | yareicillo            |
| <i>Myrica cerifera</i> L.  | arraigán              |
| <i>Myrsine coriacea</i> (Sw.) R. Br. ex Roem.                          | camaguilla            |
| <i>Ocotea cuneata</i> (Griseb.) Urb.                                   | canelón               |
| <i>Ocotea floribunda</i> (Sw.) Mez                                     | boniato laurel        |
| <i>Ocotea globosa</i> Schlecht. & Cham.                                | -                     |
| <i>Ocotea leucoxylon</i> (Sw.) Laness.                                 | toad                  |

|  |                        |
|--|------------------------|
| <i>Octomeria tridentata</i> Lindl.   | -                      |
| <i>Odontosoria jenmanii</i> Maxon  | -                      |
| <i>Odontosoria scandens</i> (Desv.) C. Christ.   | tembladera             |
| <i>Oeceoclades maculata</i> (Ldl.) Ldl.  | -                      |
| <i>Olyra latifolia</i> L.  | tibisí                 |
| <i>Oplismenus setarius</i> (Lam.) R. & S.  | cañamazo               |
| <i>Oplonia tetrasticha</i> (Wr. ex Griseb.) Stearn.  | no me toques           |
| <i>Ossaea granulata</i> Urb.   | -                      |
| <i>Oxandra lanceolata</i> (Sw.) Baill.   | yaya                   |
| <i>Palicourea alpina</i> (Sw.) DC.   | tapa camino            |
| <i>Panicum glutinosum</i> Sw.  | pega pega              |
| <i>Panicum</i> sp.   | -                      |
| <i>Paspalum breve</i> Chase  | cañamazo               |
| <i>Passiflora foetida</i> L.   | pasionaria hedionda    |
| <i>Passiflora penduliflora</i> Bert.   | bejuco manteca         |
| <i>Passiflora sexflora</i> Juss.   | pasionaria de cerca    |
| <i>Passiflora suberosa</i> L.  | bejuco mantequilla     |
| <i>Pavonia fructicosa</i> (Mill.) Fawcett & Rendle   | tábano                 |
| <i>Pavonia spinifex</i> (L.) Cav.  | malaguilla de costa    |
| <i>Peperomia maculosa</i> (L.) Hook.   | -                      |
| <i>Peperomia magnoliaefolia</i> (Jacq.) A. Dietr.  | -                      |
| <i>Peperomia rotundifolia</i> (L.) K.  | lengua de las mujeres  |
| <i>Peperomia tenella</i> A. Dietr.   | -                      |
| <i>Peperomia</i> sp.   | -                      |
| <i>Peperomia</i> sp. 1   | -                      |
| <i>Peperomia</i> sp. 2   | -                      |
| <i>Persea anomala</i> Britt. & Wils.   | aguacate cimarrón      |
| <i>Petiveria alliacea</i> L.   | anamú                  |
| <i>Phaius tankervilleae</i> (Banks) Blume  | -                      |
| <i>Pharus glaber</i> K.  | pelo de perro          |
| <i>Philodendron lacerum</i> (Jacq.) Schott   | bejuco lombricero      |
| <i>Phyla nodiflora</i> (L.) Greene   | oro azul               |
| <i>Phyllanthus epiphyllanthus</i> L.   | panetela               |
| <i>Phyllostylon brasiliensis</i> Cap.  | jatía                  |
| <i>Picramnia pentandra</i> Sw.   | aguedita               |
| <i>Picrodendron baccatum</i> Kruge & Urb.  | accituna               |
| <i>Pictetia mucronata</i> (Griseb.) Beyra & Lavin  | -                      |
| <i>Pilosocereus brooksianus</i> (Vamp.) Bol. & Row.  | jjjira                 |
| <i>Pinus maestrensis</i> Bisse   | pino de la maestra     |
| <i>Piper</i> sp.   | -                      |
| <i>Piscidia piscipula</i> (L.) Sargent.  | guamá candelón         |
| <i>Pisonia aculeata</i> L.   | zarza                  |
| <i>Pithecoctenium echinatum</i> (Aubl.) Schum.   | huevo de toro          |
| <i>Platygyne dentata</i> Alain   | -                      |
| <i>Pleurothallis gelida</i> Ldl.   | flor de llantén        |
| <i>Pleurothallis sertularioides</i> (Sw.) Spreng.  | -                      |
| <i>Plumbago scandens</i> L.  | malacara               |
| <i>Plumeria emarginata</i> Griseb.   | lirio amarillo, suchel |
| <i>Poepigia procera</i> Presl.   | tengue                 |
| <i>Politrichum</i> sp.   | -                      |
| <i>Polybotria osmundacea</i> H. & B. ex Willd.   | -                      |
| <i>Polypodium aureum</i> L.  | -                      |
| <i>Polypodium loriceum</i> L.  | -                      |
| <i>Polypodium polypodioides</i> (L.) A.S. Hith.  | -                      |
| <i>Prestoea acuminata</i> (Willd.) H.E. Moore var. <i>montana</i> (Graham) An. Hend. & Galeano | palma boba             |
| <i>Protium cubense</i> (Rose) Urb.   | copal                  |
| <i>Prunus myrtifolia</i> (L.) Urb.   | almendrillo            |

|  |                          |
|--|--------------------------|
| <i>Prunus occidentalis</i> Sw.   | cuajani                  |
| <i>Pseudocarpidium avicennioides</i> (A. Rich.) Millsp.                                  | chicharrón               |
| <i>Pseudolmedia spuria</i> Griseb.   | macagua                  |
| <i>Psidium guajava</i> L.  | guayaba                  |
| <i>Psychotria grandis</i> Sw.  | tapa camino              |
| <i>Psychotria uliginosa</i> Sw.  | tapa camino              |
| <i>Psychotria</i> sp.  | -                        |
| <i>Purdiaea stenopetala</i> Griseb. var. <i>stenopetala</i>                              | -                        |
| <i>Randia aculeata</i> L.  | agalla de costa          |
| <i>Randia spinifex</i> (R. & S.) Standl.   | espuela                  |
| <i>Rauvolfia tetraphylla</i> L.  | alelí                    |
| <i>Ravenia leonis</i> M. Vict.   | arraján                  |
| <i>Rhipsalis cassutha</i> Gaertn.  | disciplinilla            |
| <i>Rhizophora mangle</i> L.  | red mangrove             |
| <i>Rivina humilis</i> L.   | coralitos                |
| <i>Roystonea regia</i> (K.) O.F. Cook.   | royal palm               |
| <i>Salacia nipensis</i> Britt.   | -                        |
| <i>Samanea saman</i> (Jacq.) Merr.   | algarrobo                |
| <i>Sapium erythrospermum</i> Muell. Arg.   | -                        |
| <i>Sapium jamaicense</i> Sw.   | dairy                    |
| <i>Savia bahamensis</i> Britt.   | hicaquillo               |
| <i>Schefflera morototoni</i> (Aubl.) Mag., Stey. & Frodin                                | yagruma macho            |
| <i>Scirpus olneyi</i> A. Gray  | junco de tres filos      |
| <i>Scleria lithosperma</i> (L.) Sw.  | cortadera                |
| <i>Selenicereus grandiflorus</i> (L.) Britt. & Rose                                      | flor del cáliz, pitahaya |
| <i>Senna atomaria</i> (L.) Irwin. & Barneby.   | frijolillo               |
| <i>Serjania diversifolia</i> (Jacq.) Radlk.  | bejuco angarilla         |
| <i>Serjania subdentata</i> Juss.   | bejuco esquinado         |
| <i>Sida rhombifolia</i> L.   | malva, malva de cochino  |
| <i>Sideroxylon foetidissimum</i> Jacq. subsp. <i>foetidissimum</i>                       | jocuma                   |
| <i>Sideroxylon salicifolium</i> (L.) C.F. Gaertn. (= <i>Dipholis salicifolia</i> A. DC.) | cuyá                     |
| <i>Smilax havanensis</i> Jacq.   | alambrillo               |
| <i>Smilax lanceolata</i> L.  | zarparrilla              |
| <i>Solandra longiflora</i> Tuss.   | palo guaco               |
| <i>Spermacoce assurgens</i> Ruiz & Pavón   | garro                    |
| <i>Spermacoce laevis</i> Lam.  | garro morado             |
| <i>Spirotecoma</i> sp.   | -                        |
| <i>Spondias mombin</i> L.  | jobo                     |
| <i>Sticherus bifidus</i> (Willd.) Ching  | pata de gallina          |
| <i>Stigmaphyllon lineare</i> Wr.   | bejuco san pedro         |
| <i>Stigmaphyllon sagreanum</i> A. Juss.  | bejuco san pedro         |
| <i>Syzygium jambos</i> (L.) Alston in Trimen   | pomarrosa                |
| <i>Tabebuia bibracteolata</i> Griseb.  | -                        |
| <i>Tabebuia brooksiana</i> Britt.  | roble de olor            |
| <i>Tabebuia myrtifolia</i> (Griseb.) Britt.  | -                        |
| <i>Talauma orbiculata</i> Britt.   | marañón de costa         |
| <i>Thouinia patentinervis</i> Radlk.   | negracuba                |
| <i>Tillandsia balbisiana</i> Schult.   | curujey                  |
| <i>Tillandsia fasciculata</i> Sw.  | curujey                  |
| <i>Tillandsia pruinosa</i> Sw.   | curujey                  |
| <i>Tillandsia recurvata</i> L.   | curujey                  |
| <i>Tillandsia schiediana</i> Stud.   | curujey                  |
| <i>Tillandsia usneoides</i> L.   | barba de indio           |
| <i>Tournefortia glabra</i> L.  | nigua                    |
| <i>Tournefortia hirsutissima</i> L.  | nigua                    |
| <i>Tournefortia volubilis</i> L.   | nigua                    |
| <i>Tragia hexandra</i> Jacq.   | amansa guapo             |

|  |                          |
|--|--------------------------|
| <i>Tragia volubilis</i> L.                                 | -                        |
| <i>Trema micrantha</i> (L.) Blume                          | almez de flores pequeñas |
| <i>Trichilia hirta</i> L.                                  | cabo de hacha            |
| <i>Trichocentrum undulatum</i> (Sw.) Ackerman & M.W. Chace | guataca de burro         |
| <i>Trichomanes robustum</i> Fourn.                         | -                        |
| <i>Trichostigma octandrum</i> (L.) Britt.                  | bejuco de canasta        |
| <i>Triopteris rigida</i> Sw.                               | amansa guapo             |
| <i>Trophis racemosa</i> (L.) Urb.                          | ramon horse              |
| <i>Turbina corymbosa</i> (L.) Raf.                         | aguinaldo de pascuas     |
| <i>Turnera ulmifolia</i> L.                                | marilope                 |
| <i>Typha domingensis</i> (Pers.) Kunth                     | macío                    |
| <i>Urera baccifera</i> (L.) Gaud.                          | chichicate               |
| <i>Urochloa humidicola</i> (Rendle) Morrone & Zuloaga      | yerba de guinea          |
| <i>Vanilla</i> sp.   | vainilla                 |
| <i>Varronia globosa</i> L.                                 | -                        |
| <i>Varronia globosa</i> L. subsp. <i>humilis</i>           | -                        |
| <i>Varronia lineata</i> L.                                 | -                        |
| <i>Vernonia hieracioides</i> Griseb.                       | rompezaragüey            |
| <i>Vernonia</i> sp.  | -                        |
| <i>Viburnum villosum</i> Sw.                               | -                        |
| <i>Vitis tiliaefolia</i> H. & B.                           | uva cimarrona            |
| <i>Wallenia laurifolia</i> Sw.                             | casmagua                 |
| <i>Waltheria indica</i> L.                                 | malva blanca             |
| <i>Weinmannia pinnata</i> L.                               | oreganillo               |
| <i>Wissadula amplissima</i> (L.) R.E. Fries.               | -                        |
| <i>Wissadula periplocifolia</i> (L.) Presl.                | -                        |
| <i>Zamia angustifolia</i> Jacq.                            | guáyara                  |
| <i>Zanthoxylum cubense</i> P. Wils.                        | ayúa de sierra           |
| <i>Zanthoxylum elephantiasis</i> Macfd.                    | bayúa                    |
| <i>Zanthoxylum fagara</i> (L.) Sargent.                    | amoroso                  |
| <i>Zanthoxylum martinicense</i> (Lam.) DC.                 | ayúa                     |
| <i>Zapoteca gracilis</i> (Griseb.) Bässler                 | -                        |
| <i>Zeugites americana</i> Willd.                           | -                        |
| <i>Zuelania guidonia</i> (Sw.) Britt. & Millsp.            | guaguasí                 |