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# THE BUTTERFLIES AND VEGETATIONAL ZONES OF GUANAHACABIBES NATIONAL PARK, CUBA


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## INTRODUCTION

In introducing this survey of the butterflies and vegetational zones of the Guanahacabibes peninsula, a general perspective on habitat protection in Cuba is appropriate. Some seventy-eight areas in Cuba and the Isle of Pines (Isla de la Juventud) and their offshore islets have been assigned some degree of protection or are under consideration for such measures. In the southeast, the Sierra Maestra range includes three areas designated as National Parks, including Gran Piedra and the Pico Turquino massif. Several sites, notably in Pinar del Río province, are designated as Natural Monuments; a few localities are termed Wildlife Sanctuaries, while extensive areas of the Sierra del Escambray and the remainder of the Sierra Maestra as assessed for 'multiple use'.

Two areas on the Guanahacabibes peninsula, the westernmost region of Cuba, were given formal protection in 1963: 1578 hectares on Cabo Corrientes and 7585 hectares around El Beral (Samek 1968). At present, the entire peninsula west of Valle San Juan is termed a Natural/Biosphere Reserve, open to scientific research under permit, on much the same basis as National Parks in North America or Europe, and we have adopted this term for convenience.

The Guanahacabibes peninsula has had a long history of post-Columbian human presence, but the numbers colonizing this harsh terrain have always been very small. A few "fishermen's huts" were noted along the west and extreme southwest coast during a 1773 survey (Gauld 1790) and "watering wells" near Cabo San Antonio and Cabo Corrientes were included on another 18th century map (Jeffreys 1775). A small village, Roncali, was established at Cabo San Antonio when construction of the lighthouse was started in 1848, and during the mid-nineteenth century an inland track and small

settlements were established along the peninsula (Pichardo 1860-1872), the approximate positions of which are shown in Fig. **1**. The northern settlements subsisted largely on charcoal burning (primarily of *Conocarpus erectus*) and pig rearing, and while local deforestation may have encouraged incursion and spread of the mangrove fringe (*Avicennia* and *Rhizophorus*) felling was strictly controlled by the Department of Mines and Agriculture of the Spanish Government, and the main forest was little disturbed. Produce was transported to jetties near Bolondrón and Carabelita by mule-drawn rail wagons, and shipped to Mantua and elsewhere on the north coast of Pinar del Río.

After completion of the rough road from El Beral (El Veral) to Cabo San Antonio in 1970, most of these settlements were abandoned, and at the time of our last visit in 1993 only three dwellings remained at Bolondrón (Fig. **5**) and one at the site of Berraco. Patches of disturbed land remain to mark the sites of these almost, or entirely vanished communities, and the old tracks that linked them are becoming lost within the forest. The population of the Park area at its peak, from the latter decades of the last century to the first half of the present century is uncertain, but the settlements totalled perhaps 150 dwellings (Fernández, pers. comm.) and several hundred residents—many more than today. Throughout this period of colonization the peninsula was largely protected by the harshness of its terrain, and when two of the authors (LRH, A.A-M) visited Guanahacabibes in 1970 and 1975 the forests beyond the remaining settlements were virtually pristine.

Zoological work on the peninsula has been limited, though expeditions in January 1966 and February 1967 by Garrido and colleagues (Garrido and Schwartz 1968) provided lists of the birds and herpetofauna, noting the extreme difficulty of access to much of the area, at the time. Some butterflies were collected by LRH around El Beral in 1975, but the present work represents the first comprehensive account of the butterfly fauna of the Park, or indeed of any protected area of Cuba. In a recent description of a transect of the Pico Turquino area of the Sierra Maestra (Schwartz and Hedges 1991) in which observations on butterflies were incidental to other studies, 37 species were recorded. The Guanahacabibes peninsula is a particularly attractive starting point for such faunistic surveys. Its biogeographical interest as the region of Cuba closest to the Yucatán peninsula of Mexico, and the probable point of landfall for continental butterflies dispersing over-water has been noted by Alayo and Hernández (1987). Moreover, while its inaccessibility has minimized habitat degradation, the present access roads and tracks, and the paths that linked the abandoned villages, potentially open most regions of the

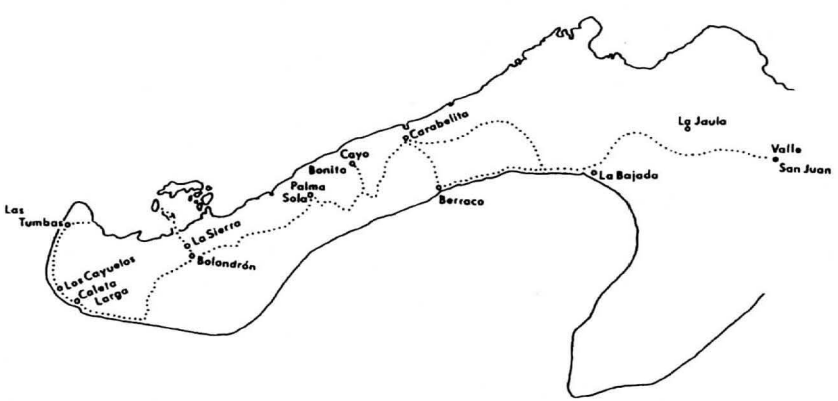



Fig. **1**. Settlements and tracks on the Guanahacabibes peninsula between the mid-nineteenth century and ca. 1970. The location of some abandoned settlements is approximate.

Park to systematic field work. The present account of the butterflies is based on four visits: 19-21 August 1992 (LRH, DSS), 19-21 October 1992 (LRH, ND), 17-20 March 1993 (LRH, DSS) and 28-31 August 1993 (LRH, DSS). The botanical information presented here was obtained by A.A-M. on our third visit, and offers the first account of the area's vegetational zones.

The geographical features and principal vegetational zones within the Park are shown in Fig. **2**. The peninsula is a low-lying area of limestone, probably emergent only since the Pleistocene (Draper, pers. comm.). It is bifid: the main arm of the peninsula is narrow, from 7 to 11km in width, ending at Cabo San Antonio, with a shorter southern promontory ending at Cabo Corrientes. The northern perimeter is continuously fringed with mangrove and marshy forest; elsewhere, the limestone substrate is largely covered by forest, the structure of which was recognized in our survey as changing appreciably, from east to west (Figs **2, 3, 4**). A variety of plant associations are found along the south coast of the main peninsula and of the Cabo Corrientes horn, along sandy beaches and on higher, rocky ridges or terraces (Fig. **6**), and a subcoastal belt of low, evergreen forest flanks the coastal vegetation east of Cabo Corrientes. These zones, and the areas of disturbed land within the Park (Fig. **5**) are described in more detail below. The Park is bordered by agricultural land along its eastern edge, from Valle San Juan, whence an all-purpose road leads to La Bajada, the site of the entry check-point and a meteorological station, and south to a hotel at María La Gorda. From La Bajada, a jeep track extends 57km to Cabo San Antonio and, a short distance beyond, to the Las Tumbas campground. A single remaining navigable track crosses the peninsula, to the all-but-abandoned village of Bolondrón (Fig. **5**), and a short track west of La Bajada gives access to two buildings administered by the Academia de Ciéncias, at El Beral.

The alternation of wet and dry seasons is very marked on the peninsula. The mean total annual rainfall recorded at Cabo San Antonio is 1455mm (57.3"), but from October to April the monthly mean is only 75mm (2.95"), rising to 186mm (7.3") from May to September. Daytime temperatures range from 28°C to 32°C from March to December, the highest temperatures most frequent in July and August and the lowest, to 20°C, occurring in January and February. Throughout the year, the wind regime of the peninsula is predominantly easterly, less often north-easterly (Sánchez et al. 1992).

## Results

### Survey of vegetational zones in the Park

The following is a descriptive summary of the principal types of vegetation recognized during our work in the Guanahacabibes Park. The approximate distribution of each is shown in Fig. 2, and the more characteristic or conspicuous plant species are listed in the Appendix.

The most extensive type of vegetation on the Guanahacabibes peninsula is a semi-deciduous limestone forest. This is present on calcareous rock, partially covered with poorly developed soils and commonly shows one or two tree layers, dominated by deciduous trees such as *Zanthoxylum martinicense*, *Mastichodendron foetidissimum*, *Ceiba pentandra* and others, and a shrubby layer principally composed of young saplings of the arboreal layer. In degraded forest, the shrubby layer may be almost absent, and this type of forest is poor in epiphytes. In the Guanahacabibes Park, we have recognized two variants of this forest type, differing primarily in the height attained by the trees, which in turn reflects greater or lesser soil depth. The sketch-map (Fig. **2**) shows the approximate extent of these, which merge one into the other, and their main features are summarized below.

**A. Tall semi-deciduous limestone forest.** The tallest limestone forest on the peninsula (Fig. **3**) is found in the east of the Park, between the entrance at Valle San Juan and La Bajada; to the north it extends to the mangrove belt, and to the south into the Cabo Corrientes promontory, where it gradually becomes replaced by a lower forest, similar to that of the main peninsula. This taller forest is associated with a somewhat better developed soil, occasionally covering the limestone almost completely. It often has

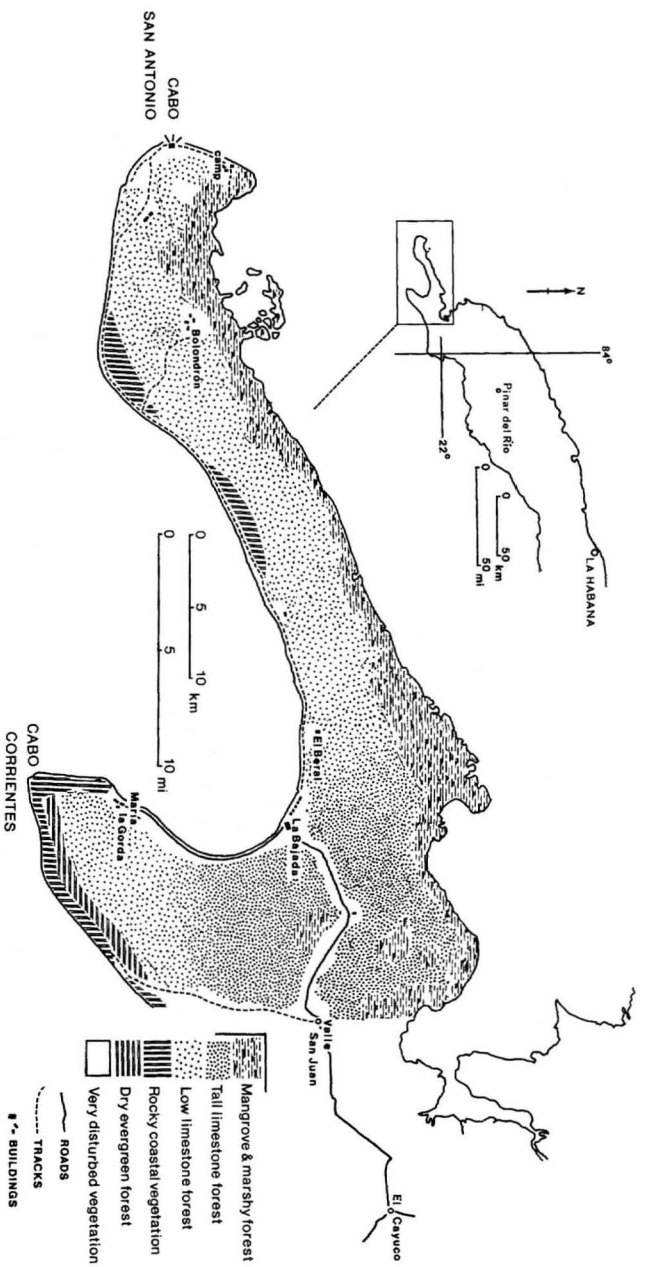



Figure 2. Map of the present distribution of main vegetational types in the Guanahacabibes Park, with roads, tracks and settled areas. Note: details of the vegetational zones are given in the **Appendix**.



Figures **3-4**. (**3**) The tall limestone forest between Valle San Juan and La Bajada. Note secondary growth; A.A-M. marks a recently felled large *Terminalia* stump. (**4**) The low limestone forest along the track to Bolondrón. Note substrate of exposed rock.

one or two tree strata, the higher reaching 12-18m with isolated trees emerging to 20-22m. The lower tree layer generally reaches 6-10m: the shrubby understorey in this type of forest is now generally substantially damaged; hence, the lower tree level is more open than in the forest of the main peninsula. A characteristic tree of the tall forest is *Laurocerasus occidentalis*, and by contrast with the forest of the main peninsula, some tree species, including *Oxandra lanceolata*, *Exothea paniculata* and *Caesalpinia violacea* are uncommon or rare. Selective felling and degrading of this forest often leads to an increase in rapidly growing, sun-loving plants, such as *Cecropia peltata*, *Bursera simaruba* and many others.

**B. Low semi-deciduous limestone forest.** This forest variant (Fig. **4**) is found west of La Bajada on the main peninsula, and also on the southern half of the Cabo Corrientes promontory. It generally shows a single tree layer, 5-10m in height, with isolated trees emerging to 15m. This type of forest grows on the almost plant-free, bare outcropping limestone rock, and a dense, shrubby understorey is usually well preserved. Common trees include *Oxandra lanceolata*, *Caesalpinia violacea*, *Guaiacum sanctum* and *Belairia ternata*, the first of which is sometimes very abundant.

**C. Mangrove and marshy forest.** An extensive fringing successional mangrove forest is developed along the low north coast of the main peninsula. Four arboreal species are involved: *Rhizophora mangle*, *Avicennia germinans*, *Laguncularia racemosa* and *Conocarpus erecta*, forming a single stratum 5-15m in height. Shrubby understorey, lianas and epiphytes are virtually absent from this zone. A tall, marshy forest is frequently developed behind the mangrove succession, and in low areas which become temporarily flooded but without saline incursion. Species characteristic of this formation include *Bucida buceras*, *Annona glabra* and *Lonchocarpus sericeus*. Only these dominant species are listed in the Appendix, since these forest types were not specifically included in the butterfly sampling.

**D. Beach and Sea-grape coastal belt.** The beach vegetation forms a fringe, in most places 10-40m in width, developed on the coastal sand along the south coast of the main peninsula. It comprises, in the main, herbaceous plants and creepers under 0.5m in height, with some low shrubs. Among the former are *Ipomoea pes-caprae*, *Sporobolus virginicus* and *Sesuvium portulacastrum* and, among the latter, *Tournefortia gnaphalodes*. This zone generally makes a transition to the sea-grape belt. On the Guanahacabibes peninsula, this formation often alternates with the rocky coastal vegetation of the raised, rocky terraces (see below, and Fig. **6**) to form a 'sand-rock vegetational complex'. Behind the sandy beaches, a narrow belt of subcoastal forest is commonly present, generally 4-10m in height, occasionally reaching 15m, in which the most characteristic constituent species is *Coccoloba uvifera*, but with *Thrinax radiata* and *Bursera simaruba* also often abundant. Low plants accompanying this belt, which makes a transition to the low semi-deciduous limestone forest, include *Chrysobalanus icaco*, *Gymnanthes lucida*, *Caesalpinia crista* and others.

**E. Coastal thickets, rocky coastal vegetation and dry evergreen forest**. The coastal vegetation along the southern perimeter of the main peninsula and the Cabo Corrientes promontory, other than that developed in association with the sandy beaches, may conveniently be considered under three headings.

*Coastal thickets.* A zone of predominantly bushy vegetation, reaching a height of 1-5m, is often developed along the south coast of the main peninsula, particularly on the high coastal ridges or terraces (Figs. **2, 6**), in places on extensive areas of 'dog-tooth' limestone. The effect of constant winds on this vegetation is very obvious: most species are dwarfed and often assume the characteristic 'flag-shaped' form of wind-blown or wind-cropped plants. Typical of this formation are cacti of the genera *Harrisia* and *Opuntia*, together with other plants such as *Plumeria* sp., *Adelia ricinella*, *Casearia aculeata*, *Randia aculeata* and *Grimmeodendron eglandulosum*. Degradation of this type of vegetation within the Park is minimal.

*Rocky coastal vegetation.* This is developed on the more or less high, rocky coastal areas, alternating with the low sandy beaches along the south coast of the main peninsula, and extending along the entire southern coast of the Cabo Corrientes promontory. This



Figures **5-6**. (**5**) The settlement at Bolondrón in September 1993, with cleared land and dwellings adjacent to the forest. (**6**) The south coast of the main peninsula including beach and a raised limestone terrace.

type of vegetation is present immediately behind the active influence of the sea, and makes a transition to coastal thickets. Participants are, for the most part, low shrubs, to about 1.5m in height, notably *Rachicallis americana* and *Borrichia arborescens*, and *Suriana maritima* is abundant in patches.

*Dry evergreen forest.* A distinctive low evergreen subcoastal forest is developed behind the coastal thickets on the Cabo Corrientes promontory (Fig. **2**), where the conditions of dryness, the rocky substrate and the effects of wind impede a direct transition to the tall semi-deciduous forest or other association. Species involved are generally components of the coastal thickets, but taller than elsewhere. This forest reaches a height of 3-10m, and its presence is marked by *Dendrocereus nudiflorus*, a robust cactus indicator of this vegetational type in Cuba. Common species within this forest include *Picrodendron macrocarpum*, *Cordia galeotiana* and *Hypelate trifoliata*.

*Highly disturbed vegetation.* Within the Park are several areas, generally bordering roads and tracks, and around occupied or abandoned buildings, where the original vegetation has been disturbed by human use. Along the road through the eastern forest between Valle San Juan and La Bajada some areas cleared in the past and now abandoned are reverting to secondary scrub; others are in current use for cattle grazing or charcoal burning. The land immediately around La Bajada and along the road to María La Gorda is likewise much disturbed. On the main peninsula, local land clearance is seen at El Beral, occasionally along the coastal track, around the few remaining buildings at Bolondrón (Fig. **5**), and more extensively in the far west, notably at the Las Tumbas campground and around the lighthouse at Cabo San Antonio. Such areas support a 'man-made' vegetation with abundant exotics, introduced intentionally or otherwise. In the more open areas grasses abound, *Eleusine indica*, *Paspalum* spp., *Andropogon virginicus*, *Panicum* spp. and others are prominent. Exotic trees such as *Khaya senegalensis* and *Pachira insignis*, undesirable introductions including *Dichrostachys cinerea* and such opportunistic native plants as *Pisonia aculeata* and *Zanthoxylon fagara* become abundant. At road edges, *Solanum erianthum*, *Pluchea odorata*, *Lantana camara*, *L. involucrata*, species of *Eupatorium* and many others are conspicuous. In summary, the form of this vegetation within the Park is a mosaic of open areas, woods and pastures, very varied in the plants it exhibits, and subject to rapid change.

## Butterfly records

During each visit, records of adult butterflies were made in a series of localities, covering as wide an area of the Park as possible. We observed and collected along roadsides and tracks through the main forest areas, and along foot trails within the tall and low forests of the main peninsula and the Cabo Corrientes promontory. Coastal sites, from María La Gorda to Cabo San Antonio were visited at least twice and in some instances on each of the four periods of work. Several disturbed areas were visited on each occasion, including sites near the Park entrance at Valle San Juan, at La Bajada, María La Gorda, Bolondrón, and near the western tip of the peninsula. The fringing mangrove forest of the main peninsula was sampled only briefly; the dry evergreen forest belt near the southern coast of Cabo Corrientes was visited only on our third visit, when it was notably poor in butterflies.

At this stage in our study of the Park, our chief aim has been to document butterfly species present, rather than to attempt any assessment of population fluctuations within a locality. Time spent in each locality was determined by experience of richness or sparsity, as the distribution of nectar sources, and of butterflies, varied markedly from one visit to the next. During each period of field work, we not only revisited a number of localities but, as far as time permitted, surveyed new sites, along paths more deeply into the forests, and in other vegetational zones.

We have recorded 101 butterfly species during our recent field work in the Park. These are tabulated below, noting presence or absence of each species for each of the four visits. Collecting data are summarized under seven principal localities or groups of sites (1-7 below). Localities in which a species was conspicuously and consistently more

abundant than elsewhere are shown in the Table by italic numerals, and species recorded from single captures are indicated by asterisks.

1. Tall semi-deciduous limestone forest: collecting was carried out along foot trails north and south of the road between the Park entrance and the main check-point at La Bajada, and along the south-east perimeter track from Valle San Juan onto the Cabo Corrientes promontory.
2. Road margins, and disturbed land in the tall limestone forest.
3. Disturbed land near María La Gorda.
4. Low semi-deciduous limestone forest: collecting was carried out at sites within the forest bordering the track between La Bajada and Cabo San Antionio, near El Beral, and along the track to Bolondrón, on the north coast.
5. Areas of cleared land and secondary scrub at Bolondrón.
6. Coastal sites: areas along the south coast of the main peninsula west of El Beral, including the low beach and sea-grape belt, coastal thickets and rocky coastal vegetation on the higher terraces.
7. Areas of disturbed land at the Las Tumbas campground, near Cabo San Antonio.

A: August 1992
B: October 1992
C: March 1993
D: August 1993

| | A | B | C | D |
|---|---|---|---|---|
| DANAIDAE | | | | |
| *Danaus p. plexippus* (Linnaeus) 2 | | + | | |
| *Danaus eresimus tethys* (Forbes) 6 | + | | + | |
| *Danaus gilippus berenice* (Cramer) 3, 6, 7 | + | | | + |
| *Anetia pantherata clarescens* (Hall) ***1***, ***2***, 4, 6 | + | + | + | + |
| SATYRIDAE | | | | |
| *Calisto h. herophile* (Hübner) 1, 2 | + | + | | + |
| NYMPHALIDAE | | | | |
| *Doxocopa laure druryi* (Hübner) ***1***, 2, 4) | + | + | + | + |
| *Asterocampa idyja* (Geyer) 1 | + | | | + |
| *Archaeoprepona demophoon crassina* (Fruh.) (1, 4) | | | | + |
| *Anaea e. echemus (Doubleday)* 1* | + | | | |
| *Anaea cubana* (Druce) 2* | | | | + |
| *Siderone galanthis nemesis* (Illiger) 2, 4 | + | | | + |
| *Colobura dirce wolcotti* (Comstock) 1 | | | | + |
| *Historis acheronta semele* (Bates) 1 | + | | + | + |
| *Historis o. odius* (Fabricius) 1, 2 | | | + | + |
| *Marpesia e. eleuchea* (Hübner) 1, 4 | + | | + | + |
| *Dynamine egaea calais* (Bates) 1, ***2*** | + | + | + | + |
| *Dynamine mylitta* (Cramer) 1, ***2*** | | + | | + |
| *Lucinia s. sida* (Hübner) 1, ***2***, 4 | + | + | + | + |
| *Eunica tatila tatilista* (Kaye) 1, 4 | + | + | + | + |
| *Eunica monima* (Cramer) 4, ***6*** | + | | | + |
| *Adelpha iphicla iphimedia* (Fruh.) ***1***, 4 | + | + | + | + |
| *Junonia genoveva* (Cramer) 2 | | | | + |
| *Junonia evarete* (Stoll) ***3***, 5, 6, 7 | + | + | + | + |
| *Anartia jatrophae guantanamo* (Munroe) 2-7 | + | + | + | + |
| *Anartia chrysopelea* (Hübner) 1, ***2***, 3 | + | + | + | + |
| *Siproeta s. stelenes* (Linnaeus) 1, 2, 4, 5 | + | + | + | + |
| *Phyciodes frisia* (Poey) 2 | + | + | + | |
| *Phyciodes phaon* (Edwards) 2 | + | + | | |
| *Euptoieta hegesia* (Cramer) 2, 6 | | | + | + |
| HELICONIIDAE | | | | |
| *Heliconius charitonia ramsdeni* (Com. & Brown) 1-7 | + | + | + | + |
| *Dryas iulia nudeola* (Bates) 1-7 | + | + | + | + |
| *Dione vanillae insularis* (Maynard) 2, 3, 5-7 | + | + | + | + |

| | A | B | C | D |
|---|---|---|---|---|
| LIBYTHEIDAE | | | | |
| *Libytheana motya* (Boisd. & Leconte) ***1***, 3, 4 | + | + | + | + |
| LYCAENIDAE | | | | |
| *Ministrymon azia* (Hewitson) 2 | | | | + |
| *Strymon martialis* (Herrich-Schäffer) 4, ***6*** | + | | + | + |
| *Strymon columella cybira* (Hewitson) 4, ***6*** | + | | + | |
| *Electrostrymon a. angelia* (Hewitson) 6 | + | | + | + |
| *Leptotes cassius theonus* (Lucas) 1, 2, 4, 5, ***6*** | + | + | + | + |
| *Hemiargus hanno filenus* (Poey) 1-7 | + | + | + | + |
| *Cyclargus a. ammon* (Lucas) 3-5, ***6*** | + | + | + | + |
| PIERIDAE | | | | |
| *Ascia monuste eubotea* (Godart) 1-7 | + | + | + | + |
| *Ganyra menciae* (Ramsden) 2*, ***4***, 6 | | | + | |
| *Appias drusilla poeyi* (Butler) ***1***, 2, ***4***, 5, ***6*** | + | + | + | + |
| *Eurema nise* (Cramer) 1, 2, 4, 5 | + | + | + | + |
| *Eurema larae* (Herrich-Schäffer) 4 | + | | | |
| *Eurema daira palmira* (Poey) 2, ***3***, 7 | + | + | | + |
| *Eurema lisa euterpe* (Ménétriés) 2, 3, 5, 7 | + | | | + |
| *Eurema messalina* (Fabricius) 1, 4 | + | | | + |
| *Eurema d. dina* (Poey) 1, ***2***, 3, ***4***, 5 | + | + | + | + |
| *Eurema boisduvaliana* (Felder & Felder) 2, 4, 5 | + | | + | + |
| *Eurema nicippe* (Cramer) 2, 3, 5, 6 | + | + | + | + |
| *Nathalis iole* (Boisduval) 2, 6 | | | | + |
| *Kricogonia lyside* (Godart) 4* | | | + | |
| *Anteos maerula* (Fabricius) 2, 5 | + | | + | |
| *Anteos clorinde nivifera* (Fruh.) 2, 5, 6 | + | | + | + |
| *Phoebis p. philea* (Johansson) 2, 5 | | | + | + |
| *Phoebis agarithe antillia* (Brown) 1-7 | + | | + | + |
| *Phoebis s. sennae* (Linnaeus) 1-7 | + | + | + | + |
| *Phoebis argante fornax* (Butler) 2, 5 | | + | + | |
| *Aphrissa o. orbis* (Poey) 5 | | | + | |
| *Aphrissa neleis* (Boisduval) 5 | | | | + |
| *Aphrissa statira cubana* (d'Almeida) 2, 5, 7 | + | | + | + |
| PAPILIONIDAE | | | | |
| *Battus polydamas cubensis* (Dufrane) 3, ***6*** | + | + | + | + |
| *Heraclides thoas oviedo* (Gundlach) 2 | + | | | |
| *Heraclides a. andraemon* (Hübner) 1-7 | + | + | + | + |
| *Heraclides androgeus epidaurus* (Gdm & Salv.) 1, 2 | + | + | + | + |
| *Heraclides oxynius* (Hübner) 1* | | | + | |
| *Heraclides caiguanabus* (Poey) 1* | + | | | |
| *Protesilaus celadon* (Lucas) 2 | + | | | + |
| HESPERIIDAE | | | | |
| *Proteides maysi* (Lucas) ***1***, 2 | + | + | + | + |
| *Proteides mercurius sanantonio* (Lucas) ***1***, 2, ***4***, 5 | + | + | + | + |
| *Polygonus leo savigny* (Latreille) 1, ***3*** | + | + | | + |
| *Urbanus dorantes santiago* (Lucas) 2, 5 | + | + | + | + |
| *Urbanus proteus domingo* (Scudder) 2, 5 | + | + | + | + |
| *Aguna asander haitensis* (Mabille) 1 | + | | | |
| *Aguna claxon* (Evans) ***2***, 3 | + | + | | + |
| *Astraptes cassander* (Fabricius) 1 | | | | + |
| *Astraptes h. habana* (Lucas) 1, 4 | + | + | | + |
| *Cabares potrillo* (Lucas) ***1***, 2, 5 | + | | + | + |
| *Achlyodes mithridates papinianus* (Poey) 1, 2, 4, 5 | | + | | + |
| *Chiomara mithrax* (Möschler) 2, 4 | + | | | + |
| *Ephyriades b. brunnea* (Herrich-Schäffer) 1-6 | + | | + | + |
| *Erynnis zarucco* (Lucas) 4 | + | | | |
| *Pyrgus o. oileus* (Linnaeus) 1-7 | + | + | + | + |
| *Pyrgus crisia* (Herrich-Schäffer) 2* | | + | | |
| *Pyrrhocalles antiqua orientis* (Skinner) 4, ***5*** | + | + | | + |
| *Perichares philetes* (Gmelin) 1 | + | | | |

| | A | B | C | D |
|---|---|---|---|---|
| *Wallengrenia misera* (Lucas) 1, 5 | + | | | + |
| *Polites b. baracoa* (Lucas) 1* | | | | + |
| *Synapte m. malitiosa* (Herrich-Schäffer) 1, 2 | | + | | + |
| *Cymaenes tripunctus* (Herrich-Schäffer) 1, 2, 4, 5 | + | + | + | + |
| *Hylephila phyleus* (Drury) 5 | + | | | + |
| *Atalopedes m. mesogramma* (Latreille) 5 | | | | + |
| *Parachoranthus magdalia* (Herrich-Schäffer) 1, 4 | + | | | + |
| *Choranthus radians* (Lucas) 1, 2 | + | + | + | + |
| *Euphyes s. singularis* (Herrich-Schäffer) 5 | + | + | | |
| *Euphyes c. cornelius* (Latreille) 1* | | | | + |
| *Asbolis capucinus* (Lucas) 1, 3, 4 | + | + | | + |
| *Panoquina sylvicola* (Herrich-Schäffer) 1, 2 | + | + | + | + |
| *Panoquina o. ocola* (Edwards) 2* | | + | | |
| *Panoquina p. panoquinoides* (Gdm & Salvin) 3, 6 | + | | + | |
| Species totals: | 76 | 51 | 56 | 79 |

As noted below, the occurrence of several of these butterflies on the Guanahacabibes peninsula is noteworthy, either in providing new distributional data for the Cuban fauna or evidence of colonization from continental Central Amarica.

## NYMPHALIDAE

***Dynamine mylitta***. Unknown to Gundlach in the last century, and more recently regarded as rare and sporadic in Cuba, this continental species has been seen, at times in abundance, on the peninsula, Fontenla (1987a) found it east of the Park in the Viñales valley, where it was quite common in September 1991 (Smith and Hernández, 1993). It was flying during recent visits to Guanahacabibes and is now a well established colonist, perhaps an arrival from Yucatán. It is at present apparently restricted to western Cuba, as far east as Río Guayaibón, near Habana (Fontenla, 1987b) and it is unknown from the Isle of Pines.

***Eunica tatila.*** This forest numphalid has been looked upon as generally rare in Cuba. Alayo and Hernández (1987) note that a large 'migratory' flock reached the Guanahacabibes peninsula in 1970 from the south-west, presumably from Yucatán. We have found it locally common both in the eastern and western forest in the Park. It was evidently resident before the migration mentioned above: the 25 specimens examined all match subspecies *tatilista* (Kaye) in common with other Greater Antillean populations, in lacking minute white pupils in the underside hindwing eyespots present in most continental examples of *E. t. tatila*. Further insight into the status of Cuban, other West Indian and continental populations of this butterfly may be expected from comparison at the level of molecular genetics.

## LYCAENIDAE

***Ministrymon azia.*** This tiny hairstreak was first noted in the Park in August 1993, on *Mimosa* in disturbed land near the entrance at Valle San Juan. It was first recorded from Cuba in 1991 when found commonly in the Viñales valley, east of the Park (Smith and Hernández, 1993) and later in several localities in Sancti Spiritus, Cienfuegos and Matanzas provinces. It was first recorded in the West Indies from Jamaica (Vyhmeister et al., 1980) and is now known from many localities on each of the Greater Antilles, also from the Bahamas and the Lesser Antilles. This history may reflect remarkable recent colonizing success (Emmel et al., 1992) or, perhaps more probably, increased awareness of a very inconspicuous butterfly.

## PIERIDAE

***Ganyra menciae.*** Known in the past as a far eastern species in Cuba, occasionally common near Guantánamo, Alayo and Hernández (1987) note only isolated records from

La Habana and Matanzas provinces, in the west. We first recognized it in the Park in March 1993, when it was common in the forest of the main peninsula though almost absent from the taller eastern forest. It was perhaps overlooked on previous visits, since it much resembles *Ascia monuste*, with which it flies. Alternatively, it may be markedly seasonal, and was not found when the same localities were revisited in August of the same year.

***Eurema larae***. Another pierid with a wider distribution in Cuba than formerly recognized, *E. larae* was fairly common along the track to Bolondrón, in the low limestone forest, in August 1992, though it was not on the wing during the same month in the following year. It was found east of the Park in Pinar del Río in 1991 (Smith and Hernández, 1993). It was earlier thought to be very local, common only in central and eastern localities in Sancti Spiritus and Granma provinces.

***Eurema boisduvaliana.*** This continental species has been known from La Habana and Cienfuegos provinces, and more recently from localities in the Ciénega de Zapata and the Sierra del Escambray (Smith and Hernández, 1993). Discovery of a colony in the eastern forest of the Park may fill a gap in tracing the probable path of entry of this successful colonist, which seems to have entered Cuba during the present centory (Alayo and Hernández, 1987). Seasonal variation in the Guanahacabibes population (Figs. **9a, b**) corresponds to the dry and wet season forms elsewhere.

## PAPILIONIDAE

***Heraclides oxynius.*** The record of a single worn female in the tall limestone forest in March 1993 was unexpected since this swallowtail, though widely distributed on the island, was hitherto regarded as restricted to inland forests, particularly of the high mountains.

## HESPERIIDAE

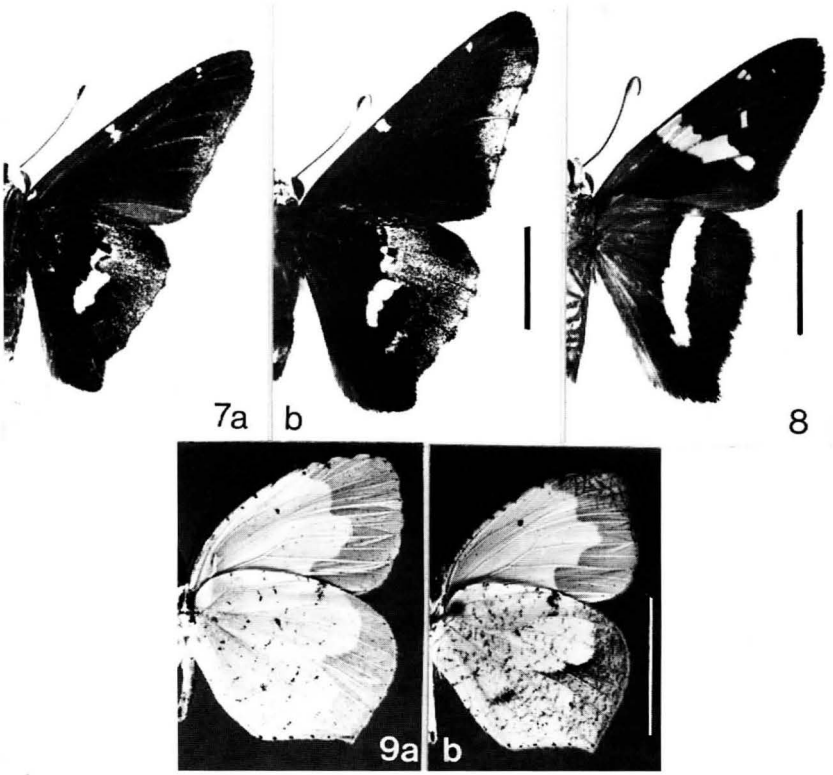
***Proteides maysi.*** Alayo and Hernández (1987) considered this a rare species of the extreme east of Cuba, but it has proved, on each visit, to be quite a common butterfly of the eastern forest in the Park, though unrecorded from the low forest of the main peninsula. It was on Holland's list (1916) for the Isle of Pines, where we encountered it in several localities in July 1993 and March 1994. The distinctive underside hindwing markings in both sexes are very variable (Figs. **7a, b**).

***Aguna claxon.*** Fresh specimens of this continental skipper were frequent on disturbed land at María La Gorda, in August 1992, rarely seen in the adjacent forest. In August of the following year, few plants were in flower in this locality, but *A. claxon* was common along foot trails through the tall limestone forest. Worn adults were found on the Guanahacabibes peninsula in 1962, which Alayo and Hernández (1987) considered as probable vagrants from Yucatán and these, or a subsequent incursion, evidently became established. This distinctive species is shown in Fig. **8**.

***Aguna asander.*** Regarded as a rare species by Alayo and Hernández (1987) from the Ciénega de Zapata and a few other localities, this skipper flies with *A. claxon* in the Park, though in our experience it is much the scarcer of the two.

***Astraptes cassander.*** Little is known of the field biology of this rarely collected skipper. It has been found occasionally in far eastern coastal localities, and Fontenla (1987a, b) found it in the west at Parque Lenin, Ciudad de La Habana province, and in the Viñales valley. We recorded it in the Guanahacabibes Park on our fourth visit, only deep within the tall limestone forest. It flew high and powerfully along deeply shaded paths, seldom descending below 5m, and settling beneath terminal leaves. Holland (1916) recorded a series from the Isle of Pines, but we did not encounter it there in July 1993 or March 1994.

***Chiomara mithrax.*** On our first visit to the Park, we collected one male of this skipper along the track through the low limestone forest, near Bolondrón. The first Cuban specimen, described as 'Cyclographa gundlachi' (Skinner and Ramsden, 1924) was




Figures **7-9**. (**7**) *Proteides maysi* underside: *a* ♂, *b* ♀. collected *in copula* 29 August 1993. Scale bar: 10mm. (**8**) *Aguna claxon* underside, 21 August 1992. Scale bar: 10mm. (**9**) *Eurema boisduvaliana* underside: *a* ♂ dry season form (18 March 1993); *b* ♂ wet season form (20 August 1992). Scale bar: 10mm.

considered by Bates (1935) to "differ only in unimportant details" from continental *C. mithrax*. Alayo and Hernández (1987) list only two subsequent records, one from Santiago de Cuba and another from Pinar del Río. The freshness of the adult collected, and a sight record of another in August 1993, on disturbed land in the tall forest, suggests that it is resident in the Park, offering the possibility of further comparison between Cuban and continental populations.

***Pyrgus crisia.*** Our record of this skipper in the tall forest extends its known range in Pinar del Río, where it was found in abundance at Soroa (Smith and Hernández, 1993). It is evidently far less rare than previously believed.

***Pyrrhocalles antiqua orientis.*** This conspicuous skipper has been considered frequent only in the extreme east of Cuba, though also known from the Viñales valley and Ciudad de La Habana (Fontenla, 1987a, b) and from the Isle of Pines (Holland, 1916). It has been found commonly on each visit to the Park, flying in disturbed land at Bolondrón and along tracks, generally on the main peninsula.

***Synapte m. malitiosa.*** This is another example of a butterfly with a much wider distribution than formerly realised. Alayo and Hernández (1987) mention it as rare or absent in the west: we found it at Pan de Azúcar, Pinar del Río, in September 1991 (Smith and Hernández, 1993) and it is established in the tall limestone forest of Guanahacabibes.

***Euphyes s. singularis.*** Recorded by Alayo and Hernández (1987) as a rare and very

local species of the far east, the record of a fresh male at Bolondrón shows it to be resident also in the far west.

***Panoquina o. ocola.*** This skipper is considered to be very rare in Cuba, though recorded from every province (Alayo and Hernández, 1987). We note a single specimen, collected along the road through the tall limestone forest.

***Panoquina p. panoquinoides.*** This species has been regarded as very scarce in Cuba, abundant at Batabanó and recorded by Skinner (1923) from localities in Pinar del Río, east of the Park. Our records extend its known range to the western tip of the island.

## Discussion

In assessing the importance of the fauna or flora of a defined and protected area on an island, not only species richness but also balance of representation of the biotas of the entire island should be considered. In both respects, the value of the Guanahacabibes National Park, a relatively undamaged area contiguous with a heavily cultivated region of Cuba is clear. During our survey, 101 butterfly species have been recorded from the Park, 58% of the 175 noted in the check-list compiled by Alayo and Hernández (1987), excluding such old and doubtful records as the continental *Philaethria dido*, *Oileus fridericus* and *Callimormus radiola*, and a few Nearctic species such as *Colias eurytheme*, *Heraclides palamedes* and *Autochton cellus*, collected on the island only once or twice. An additional species, *Vanessa cardui*, was found by LRH in 1975, evidently resident at the time in the forest near El Beral, but not seen when we recently revisited the locality. This species richness is found on an area of 780km$^2$ , only 0.07% of that of the entire island. As a first basis for comparison with the fauna lying outside the Park it may be noted that Fontenla (1987a) listed 55 species from the Viñales valley, in Pinar del Río to the east. Of these seven species, *Calisto sibylla smintheus*, *Marpesia chiron*, *Parides gundlachianus*, *Battus devilliers*, *Eumaeus atala*, *Lerodea eufala* and the seldom encountered skipper *Holguinia holguin* are unrecorded from the Park, while some 40 species on the present Guanahacabibes have yet to be recorded from the region of Viñales. Ecological and biogeographical comparisons between the faunas within, and external to the Park will be considered further elsewhere (Hernández, in preparation).

In taxonomic structure, the one hundred and one species now known from the Park compare very adequately, in proportional representation of the major families, to the Cuban list as a whole: the 24 nymphalids, 22 pierids and 32 hesperiids listed here represent, respectively, 65%, 69% and 59% of the island's total count. Of the smaller families, the danaids and papilionids are similarly well represented, with seven of thirteen, and four of seven species. The sole Cuban libytheid is common in the Park; the island's ithomiid is restricted to mountains of central and eastern Cuba, and the only riodinid is at present known only from a few localities in the far east. Only the lycaenids, with seven of seventeen species now recorded, fall below the general level; most were conspicuously scarce during our visits and the present list of these butterflies is almost certainly far from complete.

A further noteworthy aspect of the Park's butterflies lies in their level of representation of those endemic to Cuba. Defining endemism in an area such as the West Indies is less than straightforward, since vagrant inter-island movement, brief or longer lasting colonizing success, and local extinctions, are important features of these island faunas. Thus, until recently *Anaea cubana* was thought of as having evolved on, and restricted in its distribution to Cuba, but it has, for the present at least, successfully colonized Grand Cayman. The Cuban race of *Battus polydamas* was recorded from the same island in 1938, but not seen on more subsequent visits. Other Cuban butterflies have reached southern Florida in recent years: for example *Electrostrymon angelia angelia* and *Asbolis capucinus* (refs in Smith et al. 1994). Does a butterfly cease to be regarded as 'endemic' to its island of origin when it disperses, albeit transiently, to other islands? This is perhaps a semantic question, but in considering the butterflies of Guanahacabibes we have adopted a conservative view, excluding from counts of endemism butterflies known to have established colonies elsewhere, at the time of writing. On this basis, about 70

Cuban butterflies may be regarded as endemic to the island, at the specific or 'subspecific' level: 40% or so of the total of 175 species. Of the 101 known from Guanahacabibes, some 39 may be considered as endemic, by the same criteria—over half the count of endemic butterflies of the entire island. Furthermore, the Cuban list includes some 15 endemic butterflies, either restricted to montane habitats (e.g. *Anetia cubana* or *Greta cubana*) or known only from local and very distant populations (e.g. *Atlantea perezi* or *Eueides melphis cleobaea*), the range of which is extremely unlikely to extend to the Guanahacabibes peninsula. If these are excluded from candidacy, then the representation of endemic butterflies already found on the peninsula reaches 70% of the total 'potential' count of the island's endemics. We reiterate that this level of endemism, and the count of well over half the Cuban butterfly species list, are attained on land accounting for less than one per cent of the area of Cuba.

We are confident that continuing field work will not only broadly augment the present list, but also give a more detailed picture of species abundance or scarcity, and of distribution within the Park. Each visit has added additional species records; eleven were newly recorded during our fourth period of field work which, although made at the same time of year as our first, revealed considerable differences in the lists compiled and in the spatial distribution and abundance or scarcity of several species.

The biogeographical importance of the Guanahacabibes peninsula as an avenue for entry of vagrant butterflies from Central America has previously been proposed (Brown and Heineman, 1972) and documented (Alayo and Hernández, 1987). In the past, recording of immigrants along this route has depended on chance, during infrequent and sporadic visits. That the Park is a relatively undamaged area greatly increases the opportunities of assessing initial colonizing success or failure, if field work is carried out intensively and regularly. Already, we have found evidence of colonization by species formerly known from isolated captures only, and additional examples may be expected as work in the Park continues. In addition, our survey has provided new distributional data, notably in recognizing as resident a number of species formerly thought to occur only in far eastern localities, a thousand kilometers distant, and elsewhere on the island beyond Pinar del Río province. As the extent of new information on butterfly distribution grows, and fuller botanical descriptions of habitats are compiled, our understanding of lowland, dry forest and associated ecosystems in Cuba will be enhanced. Of particular interest in this context is the fauna of the Isle of Pines, covered in the south by forest comparable with that of the Guanahacabibes peninsula, and more distant from Yucatán by only 170km and which, when more fully documented, is likely to yield valuable comparative data on colonization, and on the structure of butterfly populations of substantially preserved forest.

The habitats occupied by butterflies are, to a great extent, defined by botanical ecosystems, though only a small proportion of the plants present in each are used directly, as larval hosts or as adult sources of nectar, sap exudates or decaying fruit. Knowledge of the plant communities of Guanahacabibes is essential for a fuller understanding of the distribution of butterflies and other insects, whether the Park is viewed as a faunal recipient or donor of mobile species vis-à-vis areas outside the Park, whether moving over-land from the east, or over-water from the west. In describing the vegetational zones of Guanahacabibes, we offer an introductory outline of the plant communities of the Park occupied by its butterflies, to be augmented by future botanical survey work.

At present, we have little information on the phenology of the Park's butterflies; the timing and succession of life cycles and the integration of these with rainfall, the chief determinant of butterfly and plant sesonality in Cuba, and elsewhere in the West Indies. We have hints of such seasonality in emergence, through preliminary observations on adult numbers, or of presence or absence during our visits. Of the species total recorded, only about one-third (34) were found on each of four visits, and 24 on one visit only. But adequate determination of phenology calls for long-term field study, in this or any similar area. For example, seven periods of work on Mona island, between Hispaniola and Puerto Rico, has provided only a framework on which to base a study of the complex biology of

the island's butterflies (Smith et al. 1994); Mona resembles Guanahacabibes in being largely covered in dry forest but is only some 60km$^2$ in area and with a considerably smaller count of butterfly species.

This account is intended as a starting point for a continuing survey of the butterflies and plants of the Guanahacabibes peninsula, and we hope that others will be encouraged to contribute to this endeavor. The present level of preservation of the Park is remarkable, on a populous island in which most lowland areas have long ago been lost to cultivation and farming. It is an outstandingly rich region preserved, as Mona island, by historical chance, and through its inaccessibility and harsh terrain. Its biogeographical importance has been well documented over the years and remains to be explored further. That it possesses an extraordinarily high proportion of Cuba's butterflies, and notably those endemic to the island, suggests that it will prove correspondingly rich in other insects groups, which are at present virtually unknown. Its rigorous preservation as a center of biodiversity is of great importance for future considerations of the fauna and flora of Cuba.

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## APPENDIX

The more characteristic or conspicuous plants in each vegetational zone in the Guanahacabibes Park, recorded during our survey, are listed below.

A. Tall semi-deciduous limestone forest.
B. Low semi-deciduous limestone forest.
C. Mangrove and marshy forest.
D. Beach and sea-grape coastal belt.
E. Coastal thickets, rocky coastal vegetation and dry evergreen forest.
F. Highly disturbed vegetation.

* Plants not native to Cuba. + Present; ++ abundant.

| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| *Adelia ricinella* | | + | | | + | |
| *Allophyllus cominia* | + | + | | | | |
| *Alvaradoa amorphoides* | + | + | | | | + |
| *Ampelocera crenulata* | + | | | | | |
| *Amyris balsamifera* | + | + | | | | |
| *A. elemifera* | + | + | | | | |
| *Andropogon virginicus* | | | | | | + |
| *Annona glabra* | | | + | | | |
| *Aristolochia sp.* (see Note 1) | | | | | | |
| *Avicennia germinans* | | | ++ | | | |
| *Bauhinia cumanensis* | + | + | | | | |
| *B. divaricata* | ++ | + | | | | + |

| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| *Belairia ternata* | | + | | | | |
| *Bidens alba* | | | | | | + |
| *Borrichia arborescens* | | | | | + | |
| *Bourreria sp.* | + | + | | | | |
| *Bucida buceras* | | | + | | | |
| *Bumelia salicifolia* | + | + | | | | |
| *Bursera simaruba* | ++ | ++ | | ++ | + | + |
| *Caesalpinia donduc* | | | | + | + | + |
| *C. crista* | | | | + | + | + |
| *C. violacea* | | ++ | | | | |
| *Callicarpa roigii* | | | | + | | |
| *Calophyllum antillarum* | + | | | | | |
| *Canella winteriana* | | + | | | | |
| *Casearia aculeata* | | + | | | | |
| *Cecropia peltata* | + | + | | | | + |
| *Cedrela odorata* | ++ | + | | | | |
| *Ceiba pentandra* | + | + | | | | |
| *Celtis iguanae* | | + | | | + | |
| *Chrysobalanus icaco* | | | | + | | |
| *Citharexylum fruticosum* | + | + | | | + | |
| *Coccoloba diversifolia* | | + | | | | |
| *C. uvifera* | | | | ++ | | |
| *Colubrina arborea* | + | + | | | + | |
| *Comocladia dentata* | + | + | | | + | + |
| *C. platyphylla* | + | + | | | | |
| *Conocarpus erecta* | | | ++ | + | | |
| *Copernicia sp.* | | + | | | + | |
| *Cordia collococca* | + | | | | | |
| *C. galeotinia* | | | | | + | |
| *C. gerascanthus* | ++ | ++ | | | + | + |
| *C. globosa* | | | | | + | + |
| *C. sebestena* | | + | | + | | |
| *Cupania macrophylla* | + | | | | | + |
| *Dendrocereus nudiflorus* | | | | | + | |
| *Dendropanex arboreus* | + | + | | | | |
| *Dichrostachys cinerea** | | | | | | ++ |
| *Diospyros crassinervia* | + | + | | | + | + |
| *Drypetes alba* | + | + | | | | |
| *D. mucronata* | | | | | + | |
| *Ehnetia tinifolia* | + | + | | | | |
| *Eleusine indica** | | | | | | + |
| *Erythroxylum areolatum* | + | ++ | | | | |
| *E. havanense* | + | ++ | | + | ++ | |
| *Eugenia axillaris* | + | ++ | | | | |
| *E. maleolens* | + | + | | + | + | |
| *Eupatorium odoratum* | | | | | | ++ |
| *Exothea paniculata* | | + | | | | |
| *Ficus aurea* | + | | | | | |
| *F. crassinervia* | + | + | | | | + |
| *F. jacquinifolia* | | | | | + | |
| *F. subscabrida* | + | | | | | |
| *Grimmeodendron eglandulosum* | | | | | + | |
| *Guaicum sanctum* | | + | | | | |
| *Guazama ulmifolia* | + | + | | | | + |
| *Guettarda sp.* | | + | | | | |
| *Gymnanthes lucida* | + | ++ | | + | + | |
| *Hamelia patens* | + | + | | | + | + |
| *Harrisia taetra* | | | | | + | |
| *Hebestigma cubense* | | + | | | | |
| *Hibiscus elatus* | + | | | + | | |
| *Hippomane mancinella* | | | | | + | |

| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| *Hypelate trifoliata* | + | + | | | + | |
| *Ipomoea pes-caprae* | | | | + | | |
| *Jacaranda coerulea* | + | + | | | | |
| *Khaya senegalensis** | | | | | | + |
| *Laguncularia racemosa* | | | ++ | | | |
| *Lantana camara* | | | | | | + |
| *L. involucrata* | | | | + | ++ | + |
| *Laurocerasus occidentalis* | + | | | | | |
| *Lonchocarpus sericeus* | | | + | | | |
| *Lysiloma bahamensis* | + | + | | | | + |
| *L. latisiliqua* | + | + | | | | |
| *Manguifera indica** | | | | | | + |
| *Mastichdendron foetidissimum* | + | + | | | | |
| *Metopium brownei* | | | | + | + | |
| *Mimosa pudica* | | | | | | ++ |
| *Nectandra coriacea* | + | ++ | | | | |
| *Opuntia dillenii* | | | | | ++ | |
| *Oxandra lanceolata* | + | ++ | | | | |
| *Pachira insignis** | | | | | | + |
| *Paspalum spp.* | | | | | | ++ |
| *Passiflora* (see Note 2) | | | | | | |
| *Picrodendron macrocarpum* | | + | | + | + | |
| *Pisonia aculeata* | + | + | | | + | + |
| *Pithecellobium lentiscifolium* | + | + | | | | |
| *Pluchea odorata* | | | | + | | + |
| *Plumeria obtusa* | | + | | | + | |
| *Pouteria dominguensis* | + | | | | | |
| *Rachicallis americana* | | | | | ++ | |
| *Rhizophora mangle* | | | ++ | | | |
| *Sabal japa* | + | + | | | | |
| *Savia sessiliflora* | + | + | | | | |
| *Schoepfia chrysophylloides* | + | + | | | | |
| *Sesuvium portulacastrum* | | | | + | | |
| *Setaria geniculata* | | | | | | + |
| *Solanum bahamense* | | | | + | + | |
| *S. erianthum* | | | | | | + |
| *Sporobolus virginicus* | | | | + | | |
| *Stachytarpheta jamaicensis* | | | | | + | + |
| *Suriana maritima* | | | | + | ++ | |
| *Swietenia mahagoni* | + | + | | | | |
| *Tabebuia angustata* | + | | | | | |
| *T. calcicola* | + | | | | | |
| *Tabernaemontana amblyocarpa* | | | | | | + |
| *Thrinax radiata* | | | | ++ | | |
| *Tournefortia gnaphalodes* | | | | + | | |
| *T. hirsutissima* | | | | | | ++ |
| *Trichilia havanensis* | + | + | | | | + |
| *T. hirta* | + | + | | | | + |
| *Urena lobata* | | | | | | + |
| *Vitis tiliaefolia* | | + | | | | |
| *Zanthoxylum elephantiasis* | + | | | | | |
| *Z. fagara* | | + | | | + | + |
| *Z. martinicense* | + | + | | | | |
| *Zeulania guidonia* | + | | | | | |

**Note 1.** One or more species of *Aristolochia* must be present, probably on rocky coastal terraces of the main peninsula, where *Battus polydamas* is abundant, but plants were not found.

**Note 2.** One or more *Passiflora* species must be present as larval foodplants of the three heliconiids common and widespread in the Park, but plants were not found.

## REFERENCES


Alayo, P.D. and Hernández, L.E. 1987. Atlas de las mariposas diurnas de Cuba (Lepidoptera: Rhopalocera). Editorial Científico-Técnica, La Habana.

Bates, M. 1935. The butterflies of Cuba. *Bull. Mus. Comp. Zool. Harvard, 78*, 63-258.

Brown, F.M. and Heineman, B. 1972. Jamaica and its butterflies. pp.478, E.W. Classey.

Emmel, T.C., Daniels, J.C., Brock, J.P., Garraway, E., Bailey, A. and Turner, T. 1992. *Tmolus azia*, a new resident hairstreak becoming more widespread in Jamaica (Lepidoptera: Lycaenidae). *Trop. Lep. 3*, 35-36.

Fontenla, J.L. 1987a. Características zoogeográficas de las ropalóceras (Insecta: Lepidoptera) de Viñales, Pinar del Río, Cuba. *Poeyana* No.339.

Fontenla, J.L. 1987b. Aspectos comparativos estructurales de tres comunidades de mariposas (Lepidoptera: Rhopalocera) en Cuba. *Poeyana* No.337.

Garrido, O.H. and Schwartz, A. 1968. Anfíbios, reptiles y aves de la peninsula de Guanahacabibes, Cuba. *Poeyana*, Ser.A, No.53, 1-68.

Gauld, G. 1790. The West end of Cuba, and part of the Colorados...surveyed by Geo. Gauld A.M. in 1773. London, Published by W. Faden, Geogr. to the King. May 12th, 1790.

Holland, W.J. 1916. The Lepidoptera of the Isle of Pines, being a list of the species collected on the island by Mr. J.L. Graf and Mr. G.A. Link, Sr., in 1910 and 1912-3. *Ann. Carnegie Mus.* 10, 487-518.

Jeffreys, T. 1775. The West Indian Atlas or a general description of the West Indies: taken from actual surveys and observations by Thomas Jeffreys, Geographer to the King, London 20 Feb. 1775.

Pichardo, D.E. 1860-72. Isla de Cuba. Carta Geotopográfica. [1860-1872]. facs. Habana, 1970.

Samek, V. 1968. La protección de la naturaleza en Cuba. *Academia de Ciéncias de Cuba, Departamento de Ecología Forestal. Serie Transformación de la Naturaleza* No.7, 3-23.

Sánchez, A. et al. 1992. Datos climatológicos de la peninsula de Guanahacabibes. *Bol. Acad. Sci. Cuba, Delegación de Pinar del Río.*

Schwartz, A. and Hedges, S.B. 1991. An elevational transect of Lepidoptera on Pico Turquino, Cuba. *Carib. J. Sci. 27*, 130-8.

Skinner, H. and Ramsden, C.T. 1924. Annotated list of the Hesperiidae of Cuba. *Proc. Acad. Sci. Philadelphia, 75*, 307-21.

Smith, D.S. and Hernández, L.R. 1993. New subspecies of *Pseudochrysops bornoi (Lycaenidae)* and *Saliana esperi* (Hesperiidae) from Cuba, with a new island record and observations on other butterflies. *Carib. J. Sci. 28*, 139-148.

Smith, D.S., Miller, L.D. and Miller, J.Y. 1994. The butterflies of the West Indies and South Florida. pp.264. Oxford University Press.

Smith, D.S., Ramos, S.J. and McKenzie, F. 1994. The butterflies of Mona Island (Puerto Rico): an approach to their origins and phenology. *Carib. J. Sci.* (in press).

Vyhmeister, G. 1980. *Tmolus azia* in Jamaica: a new record for the West Indies. *J. Lep. Soc. 34*, 60.

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