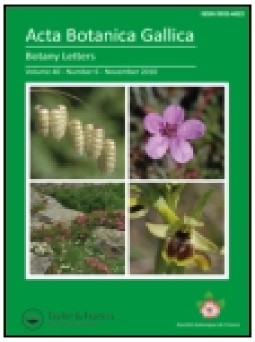

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Analysis of the *Pterocarpus officinalis* forests in the Gran Estero (Dominican Republic)

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Abstract.- This paper deals with the geological, historical, bioclimatic and floristic aspects of the northern sector of the Caribbean-Atlantic Subprovince. By means of phytosociological vegetation samples, we focussed our attention on the edaphohygrophilous *Pterocarpus officinalis* forests and megaforbic plant communities formed by large helophytes. Our paper presents a new endemic association for Hispaniola, the *Roystoneo hispaniolanae-Pterocarpetum officinalis nova*. Since this association cannot be included in any of the alliances belonging to the class *Chrysobalano-Annonetea glabrae* Borhidi & Muñiz *in* Borhidi, Muñiz & Del-Risco 1979, order *Tabebuio-Bucidetalia* (Lvov 1967) Borhidi & Del-Risco *in* Borhidi, Muñiz & Del-Risco 1979, we propose a new alliance, *Marcgravio rubrae-Pterocarpion officinalis nova*, floristically characterised by *Pterocarpus officinalis, Philodendron angustatum, Cecropia schreberiana, Cissus verticillata, Dalbergia berterii, Ficus velutina, Inga vera, Palicourea crocea*. All the edaphohigrophilous and occasionally hygrophilous forests found in swampy sites either with fresh or slightly saline water should be included in this endemic alliance.

Key words : association - alliance - hygrophilous vegetation - Caribbean.

Résumé.- Nous avons étudié les particularités géologiques, historiques, bioclimatiques et floristiques du secteur nord de la sous-province caribéenne-atlantique. Avec des relevés phytosociologiques, nous avons mené une étude des forêts édaphohygrophiles de *Pterocarpus officinalis* et des communautés à grands hélophytes. Notre étude présente une nouvelle association pour i'île d'Hispaniola, le *Roystoneo hispaniolanae-Pterocarpetum officinalis nova*. Puisque cette association ne trouve pas sa place dans la classe des *Chrysobalano-Annonetea glabrae* Borhidi & Muñiz *in* Borhidi, Muñiz & Del-Risco 1979, ordre des *Tabebuio-Bucidetalia* (Lvov 1967) Borhidi & Del-Risco *in* Borhidi, Muñiz & Del-Risco 1979, nous proposons une nouvelle alliance, le *Marcgravio rubrae-Pterocarpion officinalis nova*, caractérisée par *Pterocarpus officinalis, Philodendron angustatum, Cecropia schreberiana, Cissus verticillata, Dalbergia berterii, Ficus velutina, Inga vera, Palicourea crocea*. Toutes les forêts édaphohygrophiles et parfois hygrophiles se trouvant dans des endroits marécageux d'eau douce à saumâtre devraient être englobées dans cette alliance endémique.

Mots clés : association - alliance - végétation hygrophile - Îles Caraïbes.

I. INTRODUCTION

The absence of phytosociological research on the island of Hispaniola led us to study the Atlantic coastal territories of the Dominican Republic, particularly the plain of Gran Estero which is an alluvial river plain crossed by the Yuma river and formed in the last 500 years as a result of deforestation and the ensuing erosion. As a consequence of these changes, a large swampy plain was formed which eventually connected with the former island of Samaná producing a peninsula. The dominant vegetation is edaphohygrophilous and made up of *Pterocarpus officinalis* forests with numerous lianoid taxa, such as *Dalbergia berterii, Cissus verticillata, Paullinia pinnata, Mikania cordifolia, Ipomoea violacea*, etc. In the waterlogged forest clearings, there are *Phragmito-Magnocaricetea* communities which most frequently include *Sagittaria lancifolia, Fuirema umbellata, Eleocharis interstincta, Ludwigia octovalvis*. The study area presents a subhumid ombrotype and an infratropical thermotype, and belongs to the Northern biogeographical sector of the Caribbean-Atlantic Subprovince (Cano *et al*., 2006a). While the drier but occasionally flooded zones are used for cattle raising, the permanently flooded swampy zones, often with gleyic soils and rich in organic, non-humid matter, either show the natural vegetation or are used for growing rice.

II. MATERIAL AND METHODS

Hispaniola exhibits a wide range of geomorphological units. As far as the Dominican Republic is concerned, we have established 13 units. The following units, arranged on north-south and east-west axes, are particularly outstanding. Firstly, the Cordillera Septentrional (A1), where limestones and schists are dominant with frequent outcrops of volcanic and metamorphic rocks. To the north this unit borders on the second unit, the so-called Atlantic coastal unit, where this study was carried out (A2) and which is formed by small, alluvial river valleys with gentle slopes, frequent swamps, punctuated by limestones and reef limestones. The Peninsula of Samaná constitutes the third geomorphological unit (A4) dominated by karstic materials, limestones, schists and intrusions of siliceous materials and marbles. Meanwhile, the Cordillera Oriental constitutes the fourth unit. It presents frequent limestone outcrops, karstic landscapes, tuffs, alluvial deposits and piedmont terraces (A5, A6), (ARN, 2004) (Fig. 1).

The orographical system originated in this way presents a series of massifs. The most outstanding of all these massifs is the Cordillera Central, which encompasses the highest peaks and stretches to connect with the Massif du Nord (in the Republic of Haiti). This impressive massif originated in the Cretaceous period during the Mesozoic Era. Here the dominant materials are siliceous, igneous or volcanic, also accompanied by volcanic or metamorphic rocks and calcareous islands, which are likewise relatively frequent in the Massif du Nord. The Cordillera Central comprises the highest peaks not only on the island of Hispaniola but also in the whole of the Antilles: Pico Duarte (3,175 m), La Polona (3,087 m), La Rusilla (3,038m) and Pico del Yaque (2,761m).

The peaks of the Cordillera Oriental, a range located in the northeast part of the Dominican Republic, also originated in the Cretacean Era. However none of these are higher than 800 m.

On the other hand, the younger Cordillera Septentrional is located in the north of the island and extends from northwest to southeast, from Montecristi to the Gran Estero, near

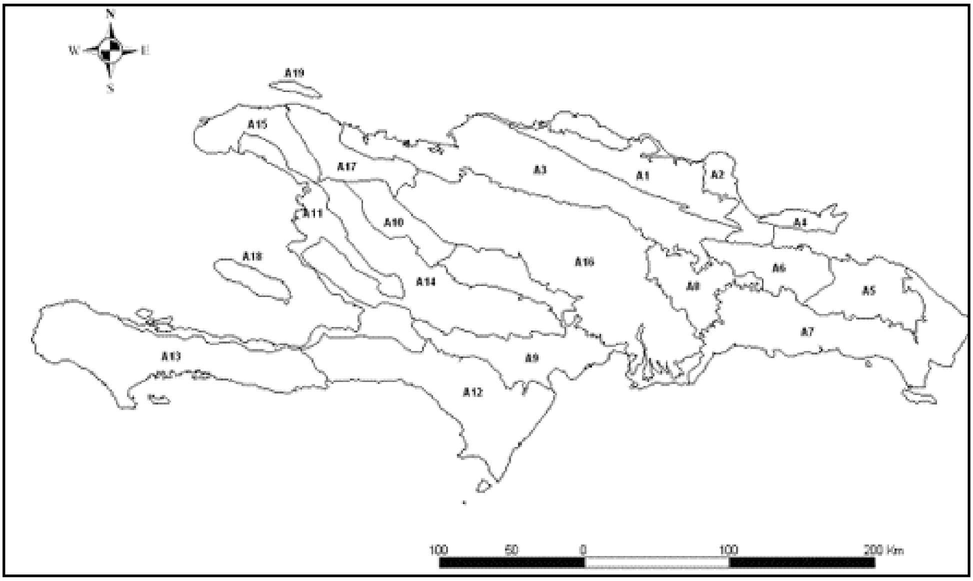

Fig. 1.- A1-A19, study areas on Hispaniola (Dominican Republic and Republic of Haiti). A2, core area under study (Atlantic coastal unit).

Fig. 1.- A1-A19, aire d´étude sur Hispaniola (République dominicaine et République d'Haïti). A2, unité littorale atlantique.

Nagua, without leaving the Dominican Republic. Originating in the Oligocene-Miocene, *i.e.* during the Tertiary Era, the range has frequent outcrops of sedimentary rocks and the most important peak is Pico Diego de Ocampo with an altitude of 1,229 m.

In addition to the above mentioned cordilleras, Hispaniola also comprises some other important ranges. The Dominican Republic encompasses, for example, Samaná, Yamasá, Neiba, Bahoruco and Martín García. Like the Cordillera Oriental, the Peninsula de Samaná also originated during the Cretaceous and its geological materials are complex: schists, calcoschists, micaceous schists and marbles (Salazar *et al.*, 1997). Large plains of quaternary origin act as linking areas between the impressive cordilleras and mountain ranges. Magnificent examples of these transit areas are, for example, the valley of Cibao, to the north, which connects the Cordillera Central with the Cordillera Septentrional, and the vast quaternary valleys facing the Atlantic Ocean, the Gran Estero and the Atlantic coastal plains.

Our floristic study is inspired in that of Liogier (2000) and Liogier (1996-2000) and our study of the vegetation is based on Hager & Zanoni (1993) and our own phytosociological samples. In this last respect, we comply with Braun Blanquet (1979).

III. RESULTS AND DISCUSSION

A. Bioclimatology

The location of Hispaniola between parallels 17º and 19 º north provides the island with a tropical climate only altered by the action of the Atlantic trade winds and the topography of the island. In fact, the climate is very similar to that of the other islands in the Greater Antilles. The average annual temperature is 25 °C and day and night and seasonal temperatures vary only very little. The warmest month is August and the coldest one is January. As for the annual rainfall rates, there are two rainy seasons, one from April to June and the other from September to November. Meanwhile, the dry season extends from December to March. Annual rainfall distribution is affected by the direction of the trade winds and the exposure of the ranges. As happens in the whole of the Greater Antilles, on Hispaniola the areas with the highest rainfall are located in the north because of the influence of the Atlantic Ocean, while the driest places tend to be concentrated in the south, *i.e.* along the Caribbean coastline, since these areas are in the shadow of the Cordillera Central. Tamayo and Dauverge, with Io = 1.4, and A. Sisal, with Io = 1.1 (semiarid ombrotype), are good examples of this effect. In this respect, Montecristi is an exceptional case. Although exposed to the Atlantic Ocean, it is, nevertheless, like any other area sheltered by the Cordillera Septentrional, a very dry site with an Io = 2.1 (dry ombrotype) (Table I).

As far as temperature and rainfall rates are concerned, altitude produces a gradient which, above 1,200-1,500 m, induces a subtropical and temperate climate. As a result, in inland valleys above 1,800 m, temperatures may reach 0 °C (Cordillera Central) in winter. Hurricanes and storms significantly alter the usual climate conditions from June to November, particularly in southern areas. These hurricanes originate in the tropics, near the Equator, and reach the Caribbean Sea driven by the south equatorial current.

On Hispaniola the rainfall rates range from 400 mm to 3,000 mm (this latter value only in specific sites). The heaviest rainfall rates are recorded at the eastern end of the Cordillera Septentrional (A1) and Haitises (A6). Here the rainfall rates range from 2,000 to 3,000 mm and Loma Quita Espuela shows the highest records of all. In the Peninsula of Samaná (A4) the rainfall rates vary between 2,000 and 2,400, while in the Cordillera Central (A16) the highest rainfall rates are concentrated in the province of Monseñor Nouel, with records ranging from 2,000 to 3,000 mm. On balance, the island rainfall rates tend to range bet-

Table I.- Meteorologic data. Tm = average temperature of the warmest month. Tmi = average temperature of the coldest month. T = average annual temperature. Tp = positive temperature. P = average annual rainfall. ETP = potential evotranspiration. Ioe = annual ombro-evaporation index. Io = ombrothermic index. Ic = continentality index.
Tableau I.- Données metéorologiques.

Site	No. sea.	Alt. (m)	Tm	Tmi	T	Tp	P	ETP	Ioe	Io	Ic
D. Miguel	0102	45	27.4	22.4	24.8	2976	1365	1525	0.89	4.5	5.0
S.R. Yuma	0193	3	28.4	24.9	27.0	3240	1241	1610	0.77	3.8	3.5
L. Romana	0199	23	27.8	24.4	26.3	3156	1080	1617	0.66	3.4	3.4
H Mayor	0255	102	28.3	24.5	26.7	3204	1548	1458	1.06	4.8	3.8
Samaná	0256	7	28.1	24.3	26.5	3180	2339	1209	1.93	7.3	3.8
Miches	0291	3	27.0	24.8	25.9	3108	1983	1327	1.49	6.3	2.2
S.P.M.	0296	3	27.5	24.8	26.0	3120	1043	1608	0.64	3.3	2.7
Matayaya	5401	430	24.8	22.5	23.7	2844	998	1561	0.63	3.5	2.3
Cevicos	0309	90	27.5	23.4	25.7	3084	2041	1223	1.66	6.6	4.1
Cabrera	0338	14	26.6	24.8	25.8	3096	2141	1264	1.69	6.9	1.8
Victoria	0346	12	27.9	25.0	26.7	3204	1806	1355	1.33	5.6	2.9
Sánchez	0352	17	28.3	25.3	27.1	3252	2024	1353	1.49	6.2	3.0
Bayaguana	0353	76	28.8	26.0	27.7	3324	1738	1416	1.22	5.2	2.8
V. Riva	0358	17	27.7	24.2	26.2	3144	2202	1229	1.79	7.0	3.5
M.Plata	0365	56	27.1	23.3	25.5	3060	1860	1276	1.45	6.0	3.8
Nagua	0387	3	26.7	24.7	25.5	3060	2183	1236	1.76	7.1	2.0
Tavera	0402	300	25.7	22.0	24.0	2880	1210	1588	0.76	4.2	3.7
S.José M	0403	530	25.6	21.3	23.0	2760	1184	1486	0.80	4.2	4.3

Santiago	0404	160	27.5	22.5	25.3	3036	824	1719	0.47	2.7	5.0
Quinigua	0405	148	29.0	23.9	26.7	3204	755	1633	0.46	2.3	6.0
Mao	0406	90	28.3	23.5	26.2	3144	642	1838	0.34	2.0	4.8
Stgo Rodri	0407	120	29.3	25.1	27.1	3252	1371	1896	0.72	4.2	4.2
La Antona	0408	48	28.1	22.9	25.9	3108	718	1919	0.37	2.3	5.2
R. S. Juan	0421	-	28.1	24.3	26.3	3156	1672	1451	1.15	5.2	3.8
Cotui	0423	60	27.0	23.1	25.5	3060	1624	1401	1.15	5.3	3.9
G. Hdfz	0435	15	27.9	24.1	26.1	3132	2099	1298	1.61	6.7	3.8
Bani	0436	60	28.7	25.3	27.0	3240	988	1668	0.59	3.0	3.4
Pimentel	0442	37	28.1	24.4	26.6	3192	1719	1424	1.20	5.3	3.7
V. Altagracia	0443	156	26.8	23.9	25.1	3012	2382	1046	2.27	7.9	2.9
R. Arriba	0449	678	23.4	19.6	21.8	2616	1648	1238	1.33	6.2	3.8
Pto. Plata	0457	24	26.9	22.8	25.0	3000	1786	1367	1.30	5.9	4.1
Santiago	0460	186	28.3	23.1	26.0	3120	971	1725	0.56	3.1	5.2
SFMacoris	0465	110	27.2	23.0	25.6	3072	1420	1485	0.95	4.6	4.2
SAB Mar	0467	3	26.5	23.7	25.3	3036	2055	1310	1.56	6.7	2.8
Cabo Enga	0478	2	27.9	24.9	26.5	3180	1027	1404	0.73	3.2	3.0
Barahona	0482	26	27.6	24.4	26.1	3132	1047	1412	0.74	3.3	3.2
San Crist	0484	44	27.3	24.1	25.8	3096	1089	1610	1.12	5.8	3.2
Airport	0485	14	27.2	24.2	25.9	3108	1075	1387	0.77	3.4	3.0
Sto. Dgo.	0486	14	27.1	23.9	25.7	3084	1394	1329	1.04	4.5	3.2
Salcedo	0489	196	27.2	23.4	25.6	3072	1225	1548	0.79	3.9	3.8
Yasica	0533	129	25.9	22.9	24.5	2940	2059	1241	1.65	7.0	3.0
Altamira	0546	310	27.2	22.5	25.1	3012	1998	1299	1.53	6.6	4.7
La Vega	0551	97	28.2	23.7	26.2	3144	1458	1509	0.96	4.6	4.5
Imbert	0557	124	26.8	22.4	24.9	2988	1772	1358	1.30	5.9	4.4
P. L. Casas	0559	510	26.0	22.0	24.5	2940	762	1610	0.47	2.5	4.0
Luperon	0589	4	27.6	23.1	25.6	3072	1321	1547	0.85	4.3	4.5
Moca	0591	83	27.2	22.7	25.3	3036	1180	1547	0.76	3.8	4.5
Azua	0595	76	28.6	25.3	27.0	3240	680	1763	0.38	2.0	3.3
Mao	0622	78	29.5	24.4	27.3	3276	750	1759	0.42	2.2	5.1
Polo	0626	703	23.0	20.0	22.1	2652	2296	999	2.29	8.6	3.0
Cabral	0655	19	27.8	24.5	26.6	3192	916	1664	0.55	2.8	3.3
Oviedo	0668	3	28.2	24.3	26.2	3144	873	1672	0.52	2.7	3.9
V. Vasquez	0659	24	29.3	24.4	-	-	699	1918	0.36	-	4.9
Temayo	0684	21	27.9	24.7	26.7	3204	480	1804	0.26	1.4	3.2
Enriquillo	0685	3	27.3	25.9	26.7	3204	1317	1556	0.84	4.1	1.4
Monción	0693	366	25.8	21.3	25.4	3048	1265	1504	0.84	4.1	4.5
Neyba	0698	-	29.1	25.9	27.9	3348	581	1838	0.31	1.7	3.2
Banica	0714	271	26.3	23.4	25.3	3036	1455	1402	1.03	4.7	2.9
Ladescur	0715	9	29.7	26.7	28.5	3420	582	1867	0.31	1.7	3.0
Salcedo	0745	5	29.2	24.8	27.2	3264	826	1736	0.47	2.5	4.4
El Cercado	0750	720	24.9	20.7	23.1	2772	1088	1447	0.75	3.9	4.2
H. Valle	0754	890	22.6	18.7	21.3	2556	1717	1139	1.50	6.7	3.9
Enfarfarn	0759	430	27.1	23.5	25.9	3108	1003	1600	0.62	3.2	3.6
Restaur	0773	594	26.1	23.3	25.1	3012	1921	1251	1.53	6.3	2.8
Duverge	0781	2	29.7	25.7	27.9	3348	482	1864	0.25	1.4	4.0
M. Cristi	0783	7	28.6	23.9	26.5	3180	690	1752	0.39	2.1	4.7
E. Pina	0784	387	28.0	24.6	27.0	3240	1618	1408	1.14	4.9	3.4
Pedernales	0715	11	29.6	25.5	27.9	3348	709	1807	0.39	2.1	4.4
Jimani	0797	31	29.3	25.0	27.3	3276	823	1739	0.47	2.5	4.3
Jingibres	1501	15	25.6	21.0	23.7	2844	1824	1237	1.47	6.4	4.6
SFMacoris	1801	160	26.4	19.9	24.4	2928	1332	1518	0.87	4.5	6.5
Jumabonao	1802	178	25.1	21.8	23.7	2844	1722	1156	1.48	6.0	3.3
FL Limon	1803	8	26.7	23.7	25.4	3048	1996	1384	1.44	6.5	3.0
El Seybo	3001	100	26.6	23.5	25.0	3000	1226	1511	0.81	4.0	3.1
Yamasa	3460	69	26.6	24.5	25.7	3084	1992	1241	1.60	6.4	3.1
Nizao	3801	600	23.8	17.8	22.1	2652	1096	1567	0.69	4.1	2.1
Peralta	4001	500	23.9	20.8	22.5	2700	1427	1321	1.08	5.2	3.1
A. Sisal	4701	40	26.6	24.5	25.7	3084	369	1849	0.19	1.1	2.1
Y. Nuevo	4901	2300	10.9	6.4	8.7	1044	995	953	1.04	9.5	4.5
Constanza	4902	1165	19.8	15.8	18.4	2208	955	1343	0.71	4.3	4.0
San J. M.	4903	378	25.7	22.8	24.7	2964	962	1734	0.55	3.2	2.9
El Penon	4904	-	27.6	23.7	25.9	3108	655	1873	0.34	2.1	3.9
Barahona	4905	23	27.6	24.4	26.3	3156	897	1625	0.55	2.8	3.2
Neyba	5301	100	27.9	25.0	27.7	3324	482	1835	0.26	1.4	2.9
S. J. Ocoa	0510	475	24.8	21.4	23.2	2784	1403	1365	1.02	5.0	3.4
Valdesia	3802	160	27.1	24.2	25.7	3084	1524	1599	0.95	4.9	2.9
A Resoli	4602	140	27.7	24.6	26.2	3144	570	1850	0.30	1.8	3.1
P Escondido	5302	400	24.4	19.9	22.6	2712	549	1628	0.33	2.0	4.5

Table II.- Meteorologic data. Tm = average temperature of the warmest month. Tmi = average temperature of the coldest month. Tmmax = average temperature of the highest records of the coldest month. Tmmi = average temperature of the lowest records of the coldest month. Tcmax. and Tcmin = average temperature of the highest records and average temperature of the lowest records of the month with the greatest daily temperature range. T = average annual temperature. Tp = positive temperature (T x 12). P = average annual rainfall rate. ETP = potential evotranspiration. Ioe = annual ombro-evaporation index (= P/ETP). Io = ombrothermic index (= Pp =P/Tp). Ic = continentality index (= Tmax-Tmi). Id = diurnality index (thermic daily range) (= Tcmax-Tcmin).
Tableau II.- Données metéorologiques.

Site	No. sea.	Alt. (m)	Tm	Tmi	Tmmax	Tmmi	Tcmax	Tcmin	T	Tp	P	ETP	Ioe	Io	Ic	Id	It/Itc
Ayo Barril (.Samaná)	78466	4	27.0	24.6	29.3	19.8	29.3	19.8	25.0	3000	2176.6	-	-	7.2	2.4	9.5	741/675
A La Unión (P. Plata)	78457	5	26.7	23.0	28.8	17.2	28.8	17.2	25.0	3000	1565	-	-	5.2	3.3	11.6	710/653
Barahona (P. Barahona)	78482	10	28.0	24.8	29.2	20.3	29.8	20.7	26.4	3168	1018.7	2451	0.41	3.2	3.2	9.1	759/701
Bayaguana (Monte Plata)	78473	61	27.6	24.7	30.1	19.3	31.5	19.7	26.5	3180	1876.2	-	-	5.9	2.9	11.8	759/698
Punta Cana (Altagracia)	78478	122	27.2	24.7	27.6	21.8	30.5	23.6	26.2	3144	1102.6	-	-	3.5	2.5	6.9	756/691
Jimani (Independencia)	78480	31	29.6	26.0	32.0	20.0	33.4	21.1	27.9	3348	728.9	-	-	2.1	3.6	12.3	799/745
L. Américas (D.Nacional)	78485	17	28.9	24.1	29.4	18.8	29.5	18.8	25.7	3084	1171.6	-	-	3.7	4.8	10.7	739/697
M. Cristi (P. Monte Cristi)	78451	7	28.5	24.1	28.9	19.2	33.8	23.3	26.5	3180	672.1	-	-	2.1	4.4	10.5	746/700
S. de la Mar (Hato Mayor)	78467	3	26.3	23.3	27.8	18.8	27.9	18.8	25.0	3000	2262.9	-	-	7.5	3.0	9.1	716/656
San Juan (P. S. Juan)	78470	415	26.3	22.5	29.6	15.3	29.6	15.3	24.8	2976	950	-	-	3.1	3.8	14.3	697/645
Santiago (P. Santiago)	78460	183	27.7	23.5	28.8	18.2	30.4	19.0	25.8	3096	1021.2	1581.2	0.64	3.2	4.2	11.4	728/680
Jarabacoa	0401	500	23.6	19.0	25.2	14.1	-	-	21.8	2529	1535	1268	1.21	5.8	4.0	-	611/561
Constanza	0584	1164	19.4	16.3	23.2	9.2	-	-	18.1	2172	1033	1301	0.79	4.7	3.1	-	505/446
La Castilla (La Vega)	-	1141	24.5	13.4	22.3	11.6	-	-	18.9	2268	1965.8	-	-	8.6	11.1	-	528/528
Loma Casabito	-	1430	17.4	15.0	-	-	-	-	16.3	1956	3853	-	-	19.7	2.4	-	487/421
Loma Humeadora	-	1315	24.0	15.5	-	-	-	-	19.7	2364	2300	-	-	9.7	9.5	-	592/592
Loma Barbacoa I	-	1300	16.5	13.5	-	-	-	-	14.9	2100	2000	-	-	11.1	3.0	-	449/389
Loma Barbacoa II	-	1350	17.0	13.2	-	-	-	-	15.5	1860	2000	-	-	10.8	4.0	-	457/407

ween 1,000 to 2,000 mm. There are, however, some sites with lower records. The lowest rainfall rates correspond to Pedernales, Parque Nacional Jaragua, Cabo Rojo, with 400-800 mm (A12), Azua, Lago Henriquillo, with 600-800 mm, (A9) and the Montecristi-Santiago axis, with 600-800 mm (A3). Consequently, in absolute terms the most xeric areas correspond to a tropical, dry bioclimate (Rivas-Martínez *et al.*, 1999). The macrobioclimate is Tropical Caribbean-Mesoamerican Pluviseasonal, Tropical Caribbean-Mesoamerican Pluvial and Tropical Caribbean-Mesoamerican Xeric, while the thermotype ranges between infratropical and supratropical, and the ombrotype between semiarid and hyperhumid (Table II).

B. Biogeography

Caribbean-Atlantic Subprovince

This province covers a number of calcareous ranges: not only Matheux, Negras, La Selle, La Hotte, Llanura Central, Noroeste, Massif du Nord, Artiobonite and Port-au-Prince in Haiti, but also the islands of Gran Caimite, Gonave, Tortugas and, in the Dominican Republic, the ranges of Bahoruco, Neiba, Martín García, Oriental, Yamasa, Prieta, Samaná, Septentrional and all the coastal plains of coralline origin and sedimentary valleys which originated in Tertiary and Quaternary periods. Consequently, the subprovince covers the areas A1 to A19, with the exception of A16. The highest peaks of the subprovince are found in the Cordillera Septentrional (Pico Diego de Ocampo, with an altitude of 1,229 m) and Sierra de Bahoruco, with an altitude of 2,367 m. There are two large valleys, Cibao and San Juan, which also connect with the Hoya de Enriquillo and the Costero Oriental plain. The soils of the territory are very complex. While calcareous rocks and recently originated coralline limestones tend to dominate, there are also materials deposited in the Quaternary period and even some gypsum outcrops in the area known as Lago Enriquillo, or serpentines in Yamasa, Prieta, Dabajón, Puerto Plata and Gaspar Hernández. In the flat areas of recent origin the infratropical thermotype and the semiarid-dry ombrotype tend to dominate, while it is normally subhumid-humid, even hyperhumid, in the rest of the territory. The whole biogeographical unit presents good examples of thermo- and mesotropical conditions and supratropical environments occur in Bahoruco, Matheaux, Neibal and Massif du Nord. The preceding factors combined with the Alpine orogeny and the interconnection of these ranges during Quaternary times have produced an extraordinary wealth of endemic species and plant communities. As a result, we propose the following biogeographical sectors for this Subprovince: 2.1, Bahoruco-Hottense (A12, A13); 2.2, Neiba-Matheux-Northwest (A14, A15, A17 and A19); 2.3, Azua-San Juan-Hoya Enriquillo-Port-au-Prince-Artiobonite-Gonaivës (A9, A10, A11 and A18); 2.4, Caribeo-Cibense (A3, A7 and A8); 2.5, Norte (A1, A2, A4, A5 and A6). The Subprovince includes, among others, the following endemic species: *Clerodendrum spinosum, Coccothrinax boschiana, Eupatorium sinuatum* var. *viscigerum, Agave antillarum, Annona dumetorum, Aristolochia ehrenbergiana, Chamaesyce adenoptera* subsp. *pergamera, Cissus oblongo-lanceolata, Coccoloba buchii, Cordia fitchii, Cubanola domingensis, Eupatorium sinuatum, Gochnatia microcephala* var. *buchii, Ipomoea furcyensis, Leptocereus weingartianus, Mosiera urbaniana, Myrcia abbottiana, Neea collina, Pavonia coccinea, Pilosocereus polygonus, Psychilis rubeniana, Tolumnia guianensis, Zombia antillarum* (Cano *et al*., 2006a; Fig. 2).

North Sector (A1, A2, A4, A5 and A6)

This Sector comprises the Cordillera Septentrional, the Peninsula of Samaná and the Cordillera Oriental, this latter including the Haitises (Mogotes). Although the Cordillera Oriental originated earlier than the other ranges, both this cordillera and the Peninsula of Samaná and the Cordillera Septentrional were islands which were eventually joined together through the accumulation of Quaternary sediments. The Peninsula of Samaná became joined to the rest of the territory from the time of the Spanish colonization, that is, during the last 500 years, probably due to the accretion of Yuma river materials, which, as a consequence of the intense deforestation in that period, filled the sea channel between the Haitises and the Cordillera Septentrional. Although the dominant materials are either limestones or coralline rocks, there are also islands of serpentines (Puerto Plata and Gaspar Hernández) along the Atlantic coastline, to the north of the Cordillera Septentrional. Despite the temperate effect of the trade winds on the It/Itc, the thermotype does not cease to be infratropical, thermo- and mesotropical, while the ombrotype ranges, in this case, between subhumid (in basal zones) and hyperhumid (in territories more overtly exposed to the trade winds). Since the macrobioclimate is Tropical Caribbean-Mesoamerican Pluvial, there is no dry season and it is only in places with serpentines that the thorny woods peculiar to dry environments can be found (Cano *et al*., 2006b). The diversity of substrates, the bioclimate and the variable dating of the zones have induced the emergence of a number of endemic species.

As a result of the effect of the trade winds, the Sector is dominated by ombrophilous, pluvial forests. These dominant evergreen broad-leaved forests present well-preserved

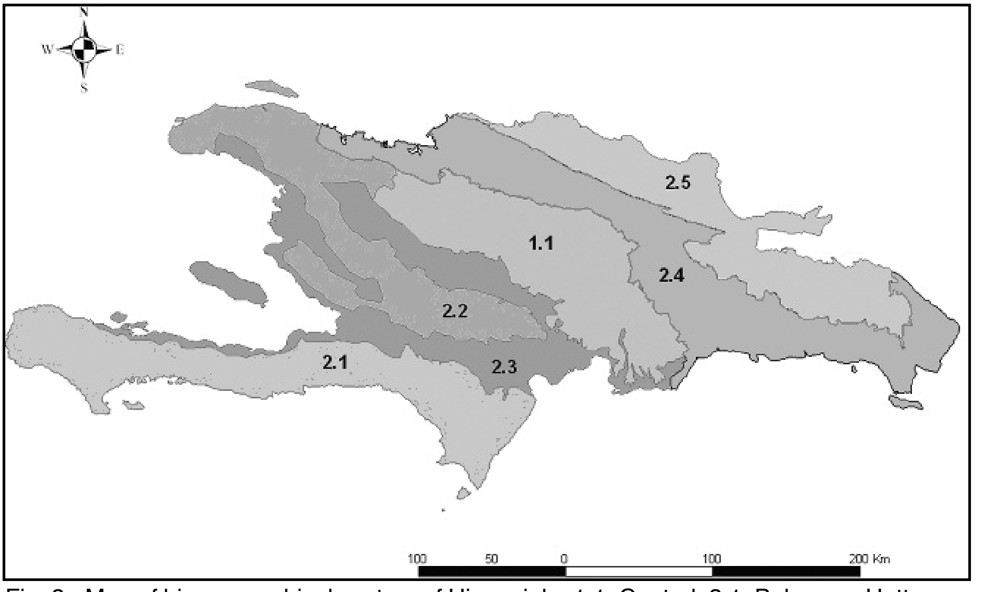

Fig. 2.- Map of biogeographical sectors of Hispaniola. 1.1, Central. 2.1, Bahoruco-Hottense. 2.2, Neiba-Matheux-Northwest. 2.3, Azua-San Juan-Hoya Enriquillo-Port-au-Prince-Artiobonite-Gonaivës. 2.4, Caribeo-Cibense. 2.5, North. Adapted from Cano *et al.* (2006a)

Fig. 2.- Carte des secteurs biogéographiques d'Hispaniola.

Prestoea montana formations in Loma Diego de Ocampo, *Mora abbottii* forests to the northeast of Cordillera Septentrional and, in areas with lower rainfall rates, mahogany forests of *Swietenia mahagoni* and *Coccoloba diversifolia.* When compared with the other sectors, this biogeographical unit not only presents significant differences as far as flora and habitats are concerned, but it also lacks the *Pinus occidentalis* forests typical of Bahoruco, Neiba and Central. However, in swampy areas there are abundant examples of coastal forests of *Bucida buceras* and other fresh water vegetation.

To the north the Cordillera Septentrional borders with the Atlantic coastal plain and to the south with the Valley of Cibao. Limestones and schists, volcanic rocks and metamorphic are the most frequent substrates in this cordillera, the youngest one on the island. Its thermotype ranges between infratropical and mesotropical, and the ombrotype varies from subhumid to hyperhumid. As far as flora is concerned, these territories present one of the lowest endemicity rates on the island: *Coccothrinax boschiana, Eupatorium trichospiroides, Gochnatia microcephala* var *buchii, Gonolobus domingensis, Ilex duartensis, Justicia spinosissima, Sagrada abbottii, Cytharexylum alainii, Mecranium septentrionale, Mikania platyloba, Tabebuia ricardii.* The dominant vegetation is that of the manaclar with *Prestoea montana, Cyrlla racemiflora, Didymopanax tremulus, Marcia splendens, Clusia clusioides, Cyathea abbottii, Dendropanax arboreus, Turpinia occidentalis, Oreopanax capitatus*. In less cloudy and, therefore, areas at lower altitude there are *Mora abbottii* forests. This species, which can also be found in the eastern areas of the Cordillera Central and in Sierra Prieta, occurs along with *Cyrilla racemiflora, Ocotea leucoxylon, Sloanea berteriana.* Among the epiphytes, *Vriesea ringens* (Hager & Zanoni, 1993) is particularly abundant. Although dramatically altered by the action of man, nowadays it is still possible to find remnants of mahogany forests at the foot of the ranges. In this case the vegetation catena corresponds to a semideciduous mahogany forest followed by a *Mora abbottii* forest to culminate in the more ombrophilous forest of *Prestoea montana*. However, in places with lower rainfall rates, it is still possible to find a usually much modified semideciduous wood with *Swietenia mahagonii, Coccoloba diversifolia, Zanthoxylum martinicense, Ocotea leucoxylon, Comocladia angustifolia, Securidaca virgata, Calophyllum calaba, Chrysophyllum argenteum, C. oliviforme, Guarea guidonia*. As for endemic species let us mention the following: *Anemia abbottii, Banara splendens, Calyptranthes garciae, Casasia samuelsonii, Chaptalia membranacea, Cissus rubrinervia, Citharexylum alainii, Coccothrinax boschiana, Daphnopsis ekamanii, Eugenia samamensis, Eupatorium sciatraphes, E. trichospermoides, Gesneria pedicellaris, Gochnatia microcephala* var *buchii, Gonolobus domingensis, Justicia spinosissima, Maytenus haitiensis, Mecranium septentrionale, Miconia samanensis, M. septentrionalis, Mikania platyloba, Murciera urbaniana, Peperomia bronetiana, P. duartensis, P. truncatula, Pilea dispar, P. samanensis, Plumeria magna, Psidium sessilifolium, Randia erythrocarpa, Sagraea abbottii, Salcedoa mirabaliarum, Salvia montecristina, Solanum dendroicum, Tabebuia ricardii, Tetranthus hirsutus, Tillandsia kuzmae, Wallenia urbaniana, Xylosma coriaceum*.

The Peninsula of Samaná, isolated from the rest of the territory until 500 years ago, is a geomorphological unit dominated by karstic materials, limestones, schists and marbles. Although the thermotype is infratropical and the ombrotype is subhumid-humid, the presence of escarpments (stacks) has induced the occurrence of edaphoxerophilous communities which must be considered as dry forest, since the following taxa dominate: *Pilosocereus polygonus, Zamia debilis, Agave antillarum, Eugenia samanensis, Bursera simaruba, Capparis flexuosa, Ficus velutina, Eugenia foetida, Opuntia dillenii, Comocladia dodonaea, Stigmaphyllum emarginatum, Croton linearis*.

The Cordillera Oriental is the oldest of the territories included in the Sector, where there is a high frequency of limestones, karstic landscapes, tuffs, alluvial deposits piedmont terraces. In the piedmont terraces, which act as a barrier with regard to the large Costero Oriental plain, Palaeozoic slates and basalt outcrops can occasionally be seen. While the ombrotype ranges from infratropical to mesotropical and the macrobioclimate reflects pluvial records, the ombrotype can vary between subhumid and hyperhumid standards. The subhumid forest, of a semideciduous character, is a transition forest combining a dry and ombrophilous profile, where *Swietenia mahagoni, Coccoloba diversifolia, Metopium toxiferum* are dominant. These formations tend to occur mostly in basal areas of the Cordillera Oriental, that is, in contact with the eastern Caribbean territories. However, the areas have been dramatically altered as a result of the farming of cacao, coconuts and coffee and also intensive cattle-raising. Above 600 m there are broad-leaved cloud forests with frequent occurrences of *Didymopanax morototoni, Inga fagifolia, Turpinia occidentalis, Cyathea arborea, Guarea guidonea, Prestoea montana, Securidaca virgata, Bactris plumeriana*. In the Haitises, with rainfall rates over 2,000 mm, there is vegetation in the valleys where *Dendropanax arboreus, Guarea guidonea, Sloanea berteriana, Prestoea montana, Turpìnia occidentalis* (Hager & Zanoni, 1993) are the dominant taxa.

C. Floristic and phytosociological analysis of the Atlantic coastal unit (A2)

The core area dealt with in this study, the Atlantic coastal unit, is formed by small alluvial river valleys with gentle slopes, frequent swamps, occasional limestones and reef limestones. Located to the north of the Cordillera Septentrional and Cordillera Oriental, the area is mostly used for the production of coconuts, coffee and cacao, or for potreros (pasturelands for cattle) and, consequently, the natural vegetation has been dramatically altered. The thermotype is infratropical and the ombrotype is subhumid and even humid. However, the presence of serpentines in Puerto Plata and Gaspar Hernández, with their corresponding edaphic xericity, led us to consider the thorny forest as a dry forest characterised by the occurrence of specific plant communities, such as *Zombia antillarum* and *Sideroxylon cubense.*

However, in the rest of the territory the potential forest is that of *Swietenia mahagoni* and *Coccoloba diversifolia.* The swampy areas of Gran Estero constitute an important feature of this territory. These are dominated by *Pterocarpus officinalis* forests which gradually give way to mangrove swamps under the influence of the sea. In these habitats *Rhizophora mangle* is the dominant species.

As far as flora is concerned, in these Atlantic coastal areas, the following endemic species can be found: *Ardisia fuertesii, A. picardea, Begonia brachypoda* var. *pilosula, Byrsonima ternifolia, Calycogonium hispidulum, Calyptranthes garciae, Cassipourea obtusa, Cinnamodendron ekmanii, Cissus oblongo-lanceolata, C. picardea, Clerodendrum spinosum, Clusia picardae, Coccothrinax argentea, C. gracilis, Cojoba filipes, Comocladia cuneata, Cubanola domingensis, Dendropemon constantinae, Diodia ekmanii, Eugenia chrootricha, Eupatorium obtusissimum, Guettarda abbottii, Hyperbaena domingensis, Jacaranda poitaei, Jacquinia eggersii, Leptogomum buchii, L. molle, Mikania papillosa, Neea collina, Phyllanthus fuertesii, Pilea gyrophylla, P. microphylla, Pimenta terebentina, Piper compostachys, P. samanense, Pitcairnia domingensis, Poitaea galegoides, Pouteria domingensis* subsp. *cuprea, Psychilis olivacea, Rhodopis planisiliqua, Rondeletia berteroana, R. fuertesii, R. liogieri, Roystonea hispaniolana, Sabal domingensis, Sideroxylon domingense, Solanum fugax, Stevensia acueleolata, Stigmaphyllon angulosum, Tabebuia berteroi, T. maxonii, T. ophiolithica, T. zanonii, Theophrasta americana, T. jussieui, Thouinia tomentosa, Tolumnia guianensis, Tragia biflora, Vitex intregrifolia, Xylosma coriaceum, Zapoteca nervosa, Zombia antillarum*.

The forests of Gran Estero, dominated by *Pterocarpus officinalis*, also show the occurrence of tree-like elements such as *Cecropia schreberiana, Annona glabra, Clusia rosea, Miconia racemosa, Roystonea hispaniolana, Ficus velutina* and a large number of climbing plants, such as *Aristolochia trilobata, Paullinia pinnata, Cissus verticillata*, the endemic taxon *Marcgravia rubra* and some epiphytes, such as *Tillandsia balbisiana, Microgramma piloselloides*. The ferns *Nephrolepis multiflora* and *Acrostichum aureum* frequently grow in the underbrush. Although there are only small islands or remnants of these woods, they have preserved a good structure only slightly altered as a result of cattle-raising and rice growing. The forests, which tend to develop on waterlogged soils, either in fresh water or in slightly saline water, grow on black soils rich in organic, unsoaked matter of gleyic character. When these woods become altered and their vegetal cover dramatically diminished they give way to the dominance of megaforbic helophytes such as Alismataceae, *Sagittaria lancifolia* and Cyperaceae, *Fuirena umbellata.* Our phytosociological study led us to include these woods in the class *Chrysobalano-Annonetea glabrae* Borhidi & Muñiz *in* Borhidi, Muñiz & Del-Risco 1979 and in the order *Tabebuio-Bucidetalia* (Lvov 1967) Borhidi & Del-Risco *in* Borhidi, Muñiz & Del-Risco 1979. Borhidi *et al.* (1979) describe the alliance *Tabebuio-Bucidion* for this order. Borhidi (1991) studied the alliance in Cuba. Since the alliance is the only one of the order, their profiles are coincidental. In this respect the order represents vegetation peculiar to swampy forests and waterlogged sites, either with fresh or slightly saline water, on deep, gleyic soils. Since

Table III, Tableau III.- *Roystoneo hispaniolanae-Pterocarpetum officinalis ass. nova.*

Altitude in m	3	10	10	20	34	12	12	15	LF	Status	Family
Area in m^2	500	1,000	2,000	2,000	2,000	2,000	2,000	1,000		S	A
Cover ratio in %	90	90	70	95	70	85	95	95		T	M
Xm/in m.	14	9	20	11	14	9	15	9		A	I
No. rel.	2	17	28	29	30	34	35	36		T	L
No. order	1	2	3	4	5	6	7	8		U	I
Characteristics of the association and higher units											
Pterocarpus officinalis	4	4	3	5	3	4	5	5	A	N	Fabaceae
Philodendron angustatum	1	+	.	3	3	2	3	3	T	N	Araceae
Cecropia schreberiana	+	.	+	.	+	+	+	1	A	N	Moraceae
Roystonea hispaniolana	+	.	+	.	+	.	+	.	A	E	Arecaceae
Cissus verticillata	.	.	+	.	1	.	.	+	T	N	Vitaceae
Dalbergia berterii	+	.	+	.	2	.	+	.	T	N	Fabaceae
Peperomia cf. glabella	.	.	+	+	+	.	+	.	EP	N	Piperaceae
Paullinia pinnata	.	.	+	2	2	.	.	.	T	N	Sapindaceae
Annona glabra	.	3	.	.	.	+	.	+	A	N	Annonaceae
Rhizophora mangle	1	.	.	.	.	.	.	.	A	N	Rhizophoraceae
Microgramma piloselloides	.	+	.	.	.	.	.	.	EP	N	Fern
Mikania cordifolia	.	.	1	.	+	1	.	.	T	N	Asteraceae
Ficus velutina	.	.	.	+	+	.	+	.	A	N	Moraceae
Aristolochia trilobata	.	.	+	.	+	.	.	.	T	N	Aristolochiaceae
Aechynomene pratensis	.	.	+	.	.	.	.	.	Ar	N	Fabaceae
Anthurium gracile	.	.	.	1	.	.	+	.	EP	N	Araceae
Cydista aequinoctalis	.	.	.	3	.	.	+	.	T	N	Bignoniaceae
Clusia rosea	.	.	+	.	.	+	.	.	A	N	Clusiaceae
Ipomoea violacea	.	+	+	.	.	.	.	.	T	N	Convolvulaceae
Entada polystachya	.	.	+	+	.	.	.	+	T	N	Mimosaceae
Hippocratea volubilis	.	.	.	.	1	.	+	.	T	N	Hippocrateaceae
Miconia racemosa	.	.	.	.	1	.	.	.	A	N	Melastomataceae
Clidemia hirta	.	.	.	.	1	.	.	.	Ar	N	Melastomataceae
Ipomoea tiliacea	.	.	.	.	.	+	+	2	T	N	Convolvulaceae
Ceiba pentandra	.	.	.	.	.	.	+	.	A	N	Bombacaceae
Scheffera morotononi	.	.	.	.	.	.	+	.	A	N	Araliaceae
Marcgravia rubra	.	.	.	.	.	.	+	.	T	E	Marcgraviaceae
Inga vera	.	.	.	.	+	.	2	.	A	N	Mimosaceae
Palicourea crocea	.	.	.	+	+	2	2	+	Ar	N	Rubiaceae
Erythrina poeppigiana	.	.	.	.	+	.	.	.	A	N	Fabaceae
Laguncularia racemosa	1	.	.	.	.	.	.	.	A	N	Combretaceae
Morinda citrifolia	+	.	.	.	.	.	.	.	A	N	Rubiaceae
Alchornea latifolia	.	.	.	.	+	.	.	.	A	N	Euphorbiaceae
Mucuna urens	.	.	.	.	+	.	.	.	T	N	Fabaceae
Companion species											
Typha dominguensis	+	+	.	.		.	.	.	H	N	Typhaceae
Eleocharis interstincta	+	+	.	.		.	.	.	H	N	Cyperaceae
Ludwigia octovalvis	+	+	1	.		.	.	.	H	N	Onagraceae
Fuirena umbellata	+	1	1	.		.	.	.	H	N	Cyperaceae
Polygonum acuminatum	+	+	.	.		.	.	.	H	N	Polygonaceae
Conmelina elegans	+	+	.	.	+	.	.	.	H	N	Commelinaceae
Polygonum punctatum	.	.	1	+	1	.	.	.	H	N	Polygonaceae
Sagittaria lancifolia	.	.	2	+	+	.	.	.	H	N	Alismataceae
Tillandsia balbisiana	.	.	+	.		.	.	.	EP	N	Bromeliaceae
Epidendron nocturnum	.	.	+	.		.	.	.			Orchidaceae
Nephrolepis multiflora	.	.	+	+	2	1	2	+	H	N	Fern
Acrostichium aureum	.	2	.	.	.	.	.	1	H	N	Fern
Rhynchospora corymbosa	.	.	+	+	1	.	.	.	H	N	Cyperaceae
Catopsis nitida	.	+	.	.		..	.	.		N	Bromeliaceae
Costus speciosus	.	.	.	2	1	+	3	2	H	N	Costaceae
Dieffenbachia seguine	.	.	.	1		2	.	.	H	Nat	Araceae
Scleria lithosperma	.	.	.	+		.	.	.		N	Cyperaceae
Callisia monandra	.	.	.	+		.	.	.	H	Nat	Commelinaceae
Piper aduncullum	.	.	.	.	+	.	.	.	Ar	N	Piperaceae
Xanthosoma caracus	.	.	.	.	+	.	.	.	H	Ic	Araceae
Urera baccifera	.	.	.	.	+	.	.	.	Ar	N	Urticaceae
Solanum jamaicense	.	.	.	.	+	.	.	.	Ar	N	Solanaceae
Desmanthus virgatus	.	.	.	.	.	+	.	.	Ar	N	Mimosaceae
Pteris longifolia	.	.	.	.	.	.	.	+	H	N	Fern

Table III, sites and localities: 1, Majagua: Punta Arena (19Q0427271/2131668). 2, Camino al Cayo Limón (19Q0454382/2135242). 3 and 4, Rincón del Melenillo (19Q0417425/2128607; 19Q0417162/2128080). 5, Gran Estero plain (19Q0415484/2126742). 6, Gran Estero (19Q0419414/2128028). 7 and 8, Near to International Airport El Catey (19Q0421822/2128909; 19Q0423222/2100159).
LF (Living forms): A. tree. Ar. shrub. T. climber. EP. epiphyte. H. grass. Status: N. native, widely distributed plant. Nat. naturalised plant. E. endemic plant.

the flora both of the order and the alliance is characterised by the taxa *Tabebuia angustata, Bucida palustris, Bucida subinermis, Fraxinus caroliniana* subsp. *cubensis, Myrsine cubana*, etc., the absence of these taxa on Hispaniola does not allow us to include the new association in this syntaxon. Consequently, we propose the new alliance *Marcgravio rubrae-Pterocarpion officinalis* to include the forest-like formations recorded on Hispaniola, which, developed on waterlogged soils, either in fresh or slightly saline water, exhibits the following characteristic taxa: *Pterocarpus officinalis, Philodendron angustatum, Cecropia schreberiana, Cissus verticillata, Dalbergia berterii, Ficus velutina, Inga vera, Palicourea crocea* which are absent in the Cuban alliance mentioned above. In this new alliance, we also include the association *Roystoneo hispaniolanae-Pterocarpetum officinalis nova* (Table III, rel. 1-8, typus rel. 1), which is the typus of the new alliance.

SYNTAXONOMICAL DIAGRAM

Cl. *Chrysobalano-Annonetea glabrae* Borhidi & Muñiz *in* Borhidi, Muñiz & Del-Risco 1979

O. *Tabebuio-Bucidetalia* (Lvov 1967) Borhidi & Del-Risco *in* Borhidi, Muñiz & Del-Risco 1979

Al. *Marcgravio rubrae-Pterocarpion officinalis nova*

As. *Roystoneo hispaniolanae-Pterocarpetum officinalis nova*

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REFERENCES

ARN, 2004.- *Atlas de los Recursos Naturales de la República Dominicana.* Ed. Frank Moya Pons, Secretaría de Estado de Medio Ambiente y Recursos Naturales, Santo Domingo, 89 p.

Borhidi, A., Muñiz & E. Del Risco, 1979.- Clasificación fitocenológica de la vegetación de Cuba. *Acta Bot. Acad. Sci. Hung*, **25**, 263-301.

Borhidi A., 1991.- *Phytogeography and vegetation ecology of Cuba.* Académiai Kiado, Budapest, 858 p.

Braun Blanquet J., 1979.- *Fitosociología. Bases para el estudio de las comunidades vegetales.* H. Blume, 820 p.

Cano E., A. García Fuentes, Y. León., A. Velóz, L. Ruiz, C. Salazar, J.A. Torres, A. Cano-Ortiz & R.J. Montilla, 2006a.- Ensayo biogeográfico de la Española. IX Congreso Latinoamericano de Botánica, 521-522.

Cano E., A. Velóz, A. García Fuentes, Y. León, L. Ruiz, C. Salazar, J.A. Tores, A. Cano-Ortiz & R:J. Montilla, 2006b.- Caracterización preliminar y biodiversidad del bosque seco en República Dominicana. IX Congreso Latinoamericano de Botánica, 346-347.

Hager J. & Th. Zanoni, 1993.- La vegetación natural de la República Dominicana: una nueva clasificación. *Moscosoa*, **7**, 39-81.

Liogier A.H., 1996-2000.- *La Flora de la Española.*, I-IX. Jardín Botánico Nacional Dr. Rafael Ma. Moscoso, Santo Domingo.

Liogier A.H., 2000.- *Diccionario Botánico de nombres vulgares de la Española*. Jardín Botánico Nacional Dr. Rafael Ma. Moscoso, Santo Domingo, 598 p.

Rivas Martínez S., D. Sánchez Mata & M. Costa, 1999.- North American boreal and western temperate forest vegetation. Syntaxonomical synopsis of the potential natural plant communities of North America, II. *Itinera Geobotanica*, **12**, 5-326.

Salazar J., B. Peguero, & A. Veloz, 1997.- Flora de la Península de Samaná, República Dominicana. *Moscosoa*, **8**, 133-188.