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Translated from the original in spanish

Original Article

Phytocoenoses in the Cupeyal-la Munición pine forest, Eastern Cuba

Fitocenosis en los pinares de Cupeyal-la Munición, Cuba Oriental

Fitocenose nos pinhais de Cupeyal-la Municion, Cuba oriental

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ABSTRACT

A general description of pine stands in the Cupeyal - La Munición region were given, using the Braun Blanquet methodology. Two associations of pine stands of *Pinus cubensis*: *Clidemio rubrinervis-Pinetum cubensis* and *Scaevolo wrightii-Pinetum cubensis* were studied. A description of their characteristic and ecological condition is detailed. The soils type mainly its depth was the most important causes of floristic and phytocenotic dissimilitudes.

Keywords: Pine forests; synecology; ophiolites; endemism.

RESUMEN

En este trabajo se realizó una caracterización general de los pinares de *Pinus cubensis* en la zona de Cupeyal-La Munición usando la metodología de Braun Blanquet. Se diferenciaron dos asociaciones: *Clidemio rubrinervis-Pinetum cubensis* y *Scaevolo wrightii-Pinetum cubensis*, de las que se efectuó una descripción de sus características y condiciones ecológicas. La principal causa de sus diferencias florísticas y fitocenóticas fue el tipo de suelo, principalmente su profundidad.

Palabras clave: Pinares; sinecología; ofiolitas; endemismo.

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RESUMO

Neste trabalho foi feita uma caracterização geral dos pinhais de Pinus cubensis na área de Cupeyal-La Munición, empregando a metodologia de Braun Blanquet. Duas associações foram diferenciadas: *Clidemio rubrinervis-Pinetum cubensis e Scaevolo wrightii-Pinetum cubensis*, para os quais foi feita uma descrição das suas características e condições ecológicas. A principal causa de suas diferenças florísticas e fitocenóticas foi o tipo de solo, principalmente sua profundidade.

Palavras-chave: Pinhais; sinecologia; ofiolitas; endemismo.

INTRODUCTION

The area known as the Cupeyal del Norte-La Munición pine forests (hereinafter Cupeyal) are mostly occupied by pine forests or glades derived from them, in which *Pteridium caudatum*, *Baccharis scoparioides* and some grasses predominate. These glades originated mainly from the cutting of trees and repeated fires that were carried out to implement pastures in order to establish livestock; undoubtedly, these fires were promoted in the pine forests and not in the broadleaf forests that are mainly submontane rainforests on offiolites (Reyes 2011-2012).

In many regions, cattle breeding has been established in the pine forests, since it is possible without much effort to obtain a grass pasture, for example, in areas of the South and Southeast of the USA, in Pinar del Río and in the Nipe High Plateau, among others.

In general, there are few phytogenic studies on Cupeyal; the most important was done by Ganchev (1972), who used other methods and determined associations of both pine and broadleaf forests, and whose results are far from those presented in this study. Borhidi (1991) also found new phytocenoses.

In the central-eastern zone of the Alejandro de Humboldt National Park of which Cupeyal is the western end, vegetation, (including pine forests and phytogenic studies have recently been carried out (Reyes and Acosta, 2005, 2012, 2017). Therefore, the aim of this work is to provide phytogenological knowledge about the pine forests in this western area, thus completing a base line of this plant formation for future studies on climate change.

Furthermore, this study is not only important in terms of its application to practice by describing the associations of pine forests and exposing the ecological conditions in which they develop, but its results were used in the typology of pine forests (Del Risco *et al.*, 2020) and can be used as a working tool in management and forestry.

MATERIALS AND METHODS

Characteristics of the area of study

The area occupied by the Cupeyal pine forests forms the eastern boundary of the Gran Meseta de Guantánamo and extends from the source of the Toa River to La Munición approximately (200.28[1]N, 750.00[1]W in the central part). They were separated from the pine forests of the Alturas de Moa and the Cuchillas del Toa by submontane rainforests over opholites and charrascales (Reyes, 2011-2012); in turn, from the pine forests of Montecristo by anthropized areas that were mesophilic evergreen forests. They form a high plateau between 700 and 800 meters above sea level with undulations.

The rocks were opholites and the soils are dark red ferritic and reddish-brown ferromagnetic ferritic (Hernández *et al.,* 2015). The average precipitation was 2 000 mm, while the average annual evaporation was 1 200 mm, and the average annual temperature varied from 20 to 220C.

Phytogenological methods

In phytogenological field research, the combined scale (Braun-Blanquet, 1950) of abundance-coverage and, in very evident cases, of diminished vitality was applied. The total projection (total coverage) of the various strata is expressed as a percentage: E_3: arboreal (more than 5 m); E_2: shrubby (between 1 and 2 m); E_1: herbaceous (between 0.05 and 1 m) and E_0: muscinal (less than 0.05 m). If the same species was repeated in two or three strata, these were recorded by combining the values in all of them to demonstrate their vertical structure.

The determination of the collected plants was made by comparing them with the specimens of the Herbario HAC de la Academia de Ciencias de Cuba HAC, at present Instituto de Ecología y Sistemática (IES).

Each phytogenic inventory was made in an area of 400 m^2 (20 x 20 m), which was established as the minimum area for this type of vegetation by the species-area curve method. The typification follows the principle of grouping the inventories according to their floristic similarity (quantitative, qualitative, structural) and thus determine the communities. The criterion to differentiate the phytocenoses was that they have half or more of the species of their dissimilar characteristic combinations; that is to say of the grade IV and V as recommended by Scamoni and Passarge (1963). Sub-associations must have a group of species that form a differential combination. Variants generally do not occupy unequal ecotypes, although they must have a differential combination. For the naming of phytocenosis, Weber *et al.,* (2000).

The determination of the elevation was made with an altimeter, the exposure with a compass and the slope (degrees) with a clinometer; the micro and mesorelief were estimated visually, as well as the fire and grazing tracks, the latter two also by surveys with the residents (gradient: ? = uncertain; - = little; + = noticeable; ++ = strong; +++ = very strong). For the substrate, layers L, F and H were characterized; in addition, the soil characteristics.

The species were named after Acevedo-Rodriguez and Strong (2012), and updated with Greuter and Rankin Rodríguez (2016, 2017), Borhidi *et al.,* (2019) and Sánchez (2017). The full names (genus, species and author) were presented in the tables as recommended by Weber et *al.,* (2000).

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RESULTS

In the Cupeyal pine forests the tree stratum is monodominant of *Pinus cubensis*, the understory is clearly differentiated and has a dense herbaceous stratum. Climbers and epiphytes were relatively rare, while lichens were frequent and sometimes abundant. Two associations were found: *Clidemio rubrinervis-Pinetum cubensis* and Scaevolo wrightii-Pinetum cubensis.

Clidemio rubrinervis-Pinetum cubensis Del Risco, Samek and Reyes ass. nov. (Holotypus. Table 1, inv. 4)

This phytocenosis, with a total of 126 species and 48.3 on average (among the inventories) has 32.7 % of endemics and of these 27.5 % are strictly from Sagua Baracoa. It occupies most of the high plateau in this zone, between approximately 720 and 810 m a.s.l (m éter a-above, s-sea, l-level), generally with a slope of between 2 and 10 degrees. It grows on dark red ferritic soils, derived from ofiolites, more or less deep, with pellets on the surface and in the profile. This ecotope has been repeatedly affected by fire and laminar erosion. The L layer is always present, but it is not abundant and does not cover the whole surface, the F and H are hardly observed.

The arboreal stratum covers between 10 and 50 % of the surface, almost exclusively of *Pinus cubensis*; the shrub reaches 50 %, more frequently between 10 and 30 %. However, the herbaceous was dense with about 80 %, with abundance of *Baccharis scoparioides*, *Schizachyrium gracile, Paspalum rupestre, Imperata contracta, Pteridium caudatum, Cladonia spp., Andropogon bicornis* and *A. macrothrix.*

The characteristic combination with 31 species is presented in Table 1. In this association two subassociations are distinguished: *typicum* and *homolepidetosum glutinosae*; those that alternate in the area and commonly present wide transition bands with continuous floristic changes. It is possible to distinguish both subassociations by the lack of species, by their differential combination and by the characteristics of the ecotope they occupy.

Clidemio rubrinervis-Pinetum cubensis typicum Del Risco and Reyes subass. nova. (Holotypus. Table 1, inv. 4)

This subassociation with 42.8 species was observed in dark red ferritic soils; always with a convex topography and moderately humid to fresh, although drier than those occupied by the other subassociation; the solum is moderately deep, with pellets and stones on the surface and throughout the profile; the affectation by laminar erosion is relatively strong. The L layer is sometimes well developed, reaching 10 cm or more in thickness, but does not cover the entire surface. In the past, these pine forests were very affected by repeated fires.

The arboreal stratum had 50 % coverage; although most of the inventories were carried out in degraded pine forests. The shrub stratum has between 10 and 50 %, while the herb stratum, when the the arboreal stratum is rale, reaches 80 % of the surface. The muscilan is fomed by lichens relatively developed and often covers 20 %. The differential combination was formed by only two species (Table 1).

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Clidemio rubrinervis-Pinetum cubensis homolepidetosum glutinosae Del Risco & Reyes subass. nova. Table 1, inv. 9)

This sub-association with 53.8 species on average, always occupied the depressions with the most humid soils, the solum was deep and with pellets on the surface, but smaller than those of the previous sub-association. The L layer was relatively well developed and covered the entire surface; lamellar erosion was noticeable and they were equally badly affected by the fire.

The tree stratum covered between 10 and 80 %, most often between 10 and 20 %, sometimes less. The shrub layer covered between 10 and 30 %, while the herb layer covered 70 to 100 %, the muscinal is well-developed and covered up to 20 %. The differential combination was formed by only two speciesin Table 1.

It was considered that the inventories in that table were ordered, and corresponding to the increase in soil moisture and this was reflected in the maximum heights of some species and in the number of species per inventory (Tabla 1).

Table 1. - Association *Clidemio rubrinervis-Pinetum cubensis* in Cupeyal del Norte-La Munición. Frec- Frequency

Sub-associations:	*Typicum*					*Homolepidetosum glutinosae*					
Inventory No.	1	2	3	4	5	6	7	8	9	10	Frec
Altitud (m.s.n.m.)	740	740	770	770	810	740	780	770	720	740	
Exposition	SO	.	.	O	S	E	S	.	E	SSO	
Slope (degrees)	3	.	.	3	10	3	2	.	2	2	
E_3- Estrato arbóreo (cobertura %)	+	+	50	30	50	+	10	80	20	20	
E_2- Estrato arbustivo (%)	20	50	30	40	10	10	30	10	20	20	
E_1- Estrato herbáceo (%)	40	80	80	80	60	70	80	100	80	80	
E_0- Estrato muscinal (%)	5	20	20	10	20	5	5	20	20	20	
Nr. especies	32	39	47	47	49	46	52	60	52	59	48.3
Characteristic combination											
E_3- *Pinus cubensis* Griseb.	2	1	4	3	3	1	2	5	2	5	V(1-5)
E_2- *Baccharis scoparioides* Griseb.	3	4	3	1	2	3	4	5	3	2	V(1-5)
Ovieda cubensis (Schauer) I. E. Méndez	1	1	1	1	1	.	(+)	r	1	1	V(r-1)
Clidemia rubrinervis (Naudin) Griseb.	+ø	1	1	1	1	1	1	1	1	1	V(+-1)
Koanophyllon polystictum (Urb.) R.M. King & H. Rob.	r	1	1	1	1	1	1	1	1	1	V(r-1)
Ilex macfadyenii (Walp.) Rehder subsp. *macfadyenii*	r	1	1	r	1	1	1	1	1	1	V(r-1)
E_1- *Andropogon bicornis* L.	1	2	1	2	2	1	2	2	1	1	V(1-2)
Schizachyrium gracile (Spreng.) Nash	2	1	2	2	2	2	2	2	2	1	V(1-2)
Andropogon macrothrix Trin.	r	2	2	2	2	1	2	r	2	.	V(r-2)
Bletia purpurea (Lam.) DC.	1	1	1	1	1	1	1	1	1	1	V(1)
Imperata contracta (Kunth) Hitchc.	.	2	1	2	1	1	2	2	2	2	V(1-2)
Dichanthelium laxiflorum (Lam.) Gould	.	2	2	2	2	1	2	2	1	1	V(1-2)
Paspalum rupestre Trin.	.	2	2	2	2	2	2	2	2	2	V(2)
H- *Pteridium caudatum* (L.) Maxon	2	1	2	2	1	2	2	2	2	2	V(1-2)
L - *Bisgoeppertia robustior* Greuter & R. Rankin	1	1	1	1	1	1	1	1	1	1	V(1)

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Ipomoea carolina L.	1	1	1	r	1	1	1	1	1	1	V(r-1)
Pentalinon luteum (L.) B.F. Hansen & Wunderlin	1	.	1	r	1	1	1	1	1	1	V(r-1)
E_0- *Cladonia* spp.	1	2	2	2	2	1	1	2	2	2	V(1-2)
E_2- *Miconia echinata* (Griseb.) Judd & al.	.	.	1	1	1	.	1	1	1	1	IV(1)
Guettarda valenzuelana A. Rich.	.	1	(+)	1	1	1	1	.	.	1	IV(+-1)
Gundlachia apiculata Britton & S. F. Blake	.	.	2	1	1	1	2	1	1	2	IV(1-2)
Lyonia macrophylla (Britton) Ekman ex Urb.	.	(+)	1	1	1	.	r	.	r	1	IV(r-1)
Miconia dodecandra (Desr.) Cogn.	rø	r	.	.		+ø	r	1	r	1	IV(r-1)
Vaccinium cubense Griseb.	1	1	1	1	1	1	1	1	(+)	1	IV(+-1)
Lepidaploa pineticola (Gleason) H. Rob.	r	.	r	1	.	1	1	r	r	1	IV(r-1)
Vernonanthura hieracioides (Griseb.) H. Rob.	1	1	.	1	.	1	1	1	1	1	IV(1)
E_1- *Rhynchospora scabrata* Griseb.	2	2	.	.	2	2	2	2	.	2	IV(2)
H- *Cyathea parvula* (Jenm.) Domin	1ø	+ø	r	.		1	1	1	1	1	IV(r-1)
Odontosoria aculeata (L.) J. Sm.	r	2		1	2	1	2	.	1	1	IV(r-2)
L- *Galactia rudolphioides* (Griseb.) Benth. & Hook. f. ex Sauvalle	.	r	1	1	.	.	1	1	1	1	IV(r-1)
Smilax domingensis Willd.	.	.	1	1	1	.	1	r	1	1	IV(r-1)
Diferenciales	*Typicum*					*Homolepidetosum glutinosae*					
E_2- *Lyonia latifolia* (A. Rich.) Griseb.	1	1	1	1	r	.	.	.	.	.	III(r-1)
E_1- *Rhynchospora tenerrima* Nees ex Spreng.	2	1	2	2	r	.	.	.	.	.	III(r-2)
E_3- *Clusia rosea* Jacq.	+ø	.	.	.	.	1	1	r	.	1	III(r-1)
E_2- *Koanophyllon ayapanoides* (Griseb.) R. M. King & H. Rob.	.	.	.	.	1	1	.	1	1	1	III(1)
Lisianthius glandulosus A. Rich.	+ø	.	.	.	.	1	1	1	.	1	III(+-1)
Myrsine guianensis (Aubl.) Kuntze	.	.	.	.	1	1	1	1	1	1	III(1)
E_1- *Homolepis glutinosa* (Sw.) Zuloaga & Soderstr.	.	.	.	.	.	2	2	2	1	2	III(1-2)
Coccocypselum herbaceum Aubl.	.	.	.	1	.	.	r	1	1	1	III(r-1)
H- *Botrichium jenmani*	.	.	.	.	.	r	r	r	1	2	III(r-2)
E_2- *Eugenia oxysepala* Urb.	.	.	.	.	.	1	1	r	(r)	.	II(r-1)
L- *Dioscorea baracoensis* (R. Knuth) Raz	.	.	.	.	.	.	1	1	1	1	II(1)
Mascagnia lucida (Kunth) W. R. Anderson & C. Davis subsp. *lucida*	.	.	.	.	.	.	.	1	1	1	II(1)
Added species											
E_2- *Bactris cubensis* Burret	.	1	.	.	r	(r)	1	1	.	.	III(r-1)
Psychotria revoluta DC.	.	.	r	1	.	.	1	.	1	1	III(r-1)
Lyonia affinis (A. Rich.) Urb.	.	.	1	1	r	1	.	.	1	1	III(r-1)
Garrya fadyenii Hook.	1	.	.	1	.	1	1	.	.	1	III(1)
Eugenia acrantha Urb.	.	1	.	.	1	.	.	1	1	1	III(1)
E_1- *Ichnanthus mayarensis* (C. Wright) Hitchc.	.	.	2	2	.	2	2	.	1		III(1-2)
L- *Stigmaphyllum* sp.	.	1	1	.	1	.	1	1	.	.	III(1)
E_1- *Hypericum nitidum* subsp. *cubense* (Turcz.) N. Robson	.	.	1	1	.	.	.	1	1	.	II(1)
Linodendron cubense (A. Rich.) Griseb.	.	1	.	.	.	1	.	.	.	1	II(1)
Matelea nipensis (Urb.) Woodson	.	.	.	.	.	.	1	1	.	1	II(1)
Miconia borhidiana Judd & al.	.	.	.	.	1	.	.	1	.	1	II(1)
Morella punctata (Griseb.) J. Herb.	r	r	.	.	.	.	.	r	.	.	II(r)
Aristida vilfifolia Henrard	(r)	.	r	2	.	.	.	.	.	.	II(r-2)
Paspalum pilosum	.	.	.	.	.	2	.	2	.	2	II(2)
Paspalum sp.	.	2	.	.	2	.	.	.	2	2	II(2)

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L- *Angadenia berteroi* (A. DC.) Miers	.	r	1	.	.	.	.	.	1	1	II(r-1)
Cynanchum sp.	.	.	.	1	1	.	.	r	.	.	II(r-1)
E_3- *Jacaranda arborea* Urb.	.	.	.	.	.	.	1	1	.	.	I(1)
Petitia domingensis Jacq.	.	.	.	.	.	1	.	.	.	1	I(1)
Tabebuia brooksiana Britton	.	.	.	.	1	.	.	1	.	.	I(1)
Tabebuia dubia (C. Wright) Britton ex Seibert	.	.	.	.	.	.	.	1	.	1	I(1)
E_2- *Psychotria thelophora* Urb.	1	.	.	.	.	.	1	.	.	.	I(1)
Schmidtottia shaferi (Standl.) Urb. subsp. *shaferi*	.	.	.	.	1	.	.	.	r	.	I(r-1)
Lepidaploa sagrana (DC.) H. Rob.	.	.	.	1	.	.	.	.	1	.	I(1)
Morella shaferi (Urb. & Britton) Berazaín & Falcón	r	.	.	.	1	.	.	.	.	.	I(r-1)
Phyllanthus polystachyus	.	1	.	.	.	r	.	.	.	.	I(r-1)
Casearia sylvestris subsp. *myricoides* (Griseb.) J.E. Gut.	.	.	.	.	.	1	.	.	.	r	I(r-1)
Grisebachianthus nipensis (B. L. Rob.) R.M. King & H. Rob.	.	.	.	.	.	.	.	1	.	1	I(1)
Guettarda calyptrata A. Rich.	.	.	.	.	1	.	.	1	.	.	I(1)
E_1- *Lobelia oxyphylla* Urb.	.	.	.	.	.	1	.	.	r	.	I(r-1)
Chaetocarpus globosus (Sw.) Fawc. & Rendle subsp. *globosus*	.	1	.	1	.	.	.	.	.	.	I(1)
Chaptalia dentata (L.) Cass.	.	.	.	.	.	.	.	r	r	.	I(r)
Sauvagesia erecta subsp. *brownei* (Planch.) Sastre	.	.	.	.	1	.	.	.	r	.	I(r-1)
Hyparrhenia rufa (Nees) Staff	.	.	.	.	.	.	.	.	r	1	I(r-1)
Panicum sp.	.	.	2	2	2	.	2	.	.	.	I(2)
Stachytarpheta jamaicensis (L.) Vahl	.	.	.	r^{ø}	r^{ø}	.	.	.	.	.	I(r)
H *Dicranopteris flexuosa* (Schrad.) Underw.	.	.	.	1	.	.	.	2	.	.	I(1-2)
E_0- *Lycopodiella cernua* (L.)	.	.	(r)	.	.	2	.	.	.	.	I(r-2)
Passiflora suberosa L.	.	.	.	.	1	.	.	.	.	1	I(1)
Ep *Epidendrum nocturnum* Jacq.	.	.	r	.	.	.	r	.	.	.	I(r)
Tillandsia sp.	.	.	r	r	.	.	.	.	.	.	I(r)

In a single inventory. Inv. 1. *Clethra cubensis* A. Rich. +; Inv. 2. *Ficus trigonata* L. r, *Mesechites roseus* (A. DC.) Miers +, *Polystachya* sp. r; Inv. 3: *Coccothtinax orientalis* (León) O. Muñiz & Borhidi r^{ø}, *Hyperbaena cubensis* (Griseb.) Urb. +, *Hypericum hypericoides* (L.) Crantz +^{ø}, *Heptanthus* sp. +, *Ouratea striata* (Tiegh.) Urb. +, *Rhynchospora tracyi* Britton +, *Rhynchospora filifolia* A. Gray +, *Cassytha filiformis* L. +; Inv. 4: *Dodonaea viscosa* Jacq. 1, *Polygala longicaulis* Kunth +, *Dichanthelium aciculare* (Poir.) Gould & C. A. Clark +, *Catopsis berteroniana* (Schult. & Schult. f.) Mez r; Inv. 5: *Chrysophyllum oliviforme* L. subsp. *oliviforme* r^{ø}, *Gordonia wrightii* (Griseb.) H. Keng (+), *Plumeria obtusa* L. subsp. *obtusa* r, *Tabebuia bibracteolata* (Griseb.) Britton r; Inv. 6. *Cyrilla nipensis* Urb. 1, *Shafera platyphylla* Greenm. +, *Machaerina cubensis* (Kük.) T. Koyama r; Inv. 7: *Buxus glomerata* (Griseb.) Müll. Arg. +, *Suberanthus canellifolius* (Britton) Borhidi & M. Fernández +, *Xylosma buxifolia* A. Gray r, *Tillandsia fasciculata* Sw. r^{ø}; Inv.8. *Brunfelsia sinuata* A. Rich. +, *Callicarpa resinosa* C. Wright ex Moldenke +, *Pera ekmanii* Urb. +, *Phaius tankervilliae* (Banks) Blume r, *Rhynchospora marisculus* Nees +, *Lygodium volubile* L. 2, *Passiflora rubra* L. +; Inv. 9. *Citharexylum spinosum* L. r, *Setaria* sp. +; Inv. 10. *Spermacoce laevis* Lam. +1, *Cassia* sp. +, *Varronia acunae* Moldenke +, *Cecropia peltata* L. r, *Guapira rufescens* (Griseb.) Lundell +, *Paspalum notatum* Flüggé +.

Scaevolo wrightii-Pinetum cubensis* Del Risco, Samek y Reyes *ass. nov. (Holotypus. Tabla 2, inv. 1)

This phytocenosis, with 99 species in total and 58 on average, had 51.6 % of endemics and of these 35.3 % are strictly Sagua Baracoa. It occupies flat places or with a strong slope, up to 30 degrees and in altitudes between 700 and 820 m a.s.l. It developed on reddish-brown fersialtic soil (ferromagnesial), the solum was deep in pockets, between the officious rock or the mocarrero (petroferric horizon), these rocks emerged in much of the area; the soil moisture was deficient and the L layer

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very thin and narrow. In general, the ecotope was considered very poor and with slow-growing pines. It was found in almost all exposures.

The tree stratum is sparse and covered 60 % of the surface, with only *Pinus cubensis* as a builder. However, the shrub and herbaceous strata are more developed and the latter can have 100 % coverage. The muscinal can cover, formed by lichens, can cover 40 % of the surface, depending on the competition from the other strata. The characteristic combination was observed in Table 2 (Tabla 1).

Table 2. - Association: *Scaevolo wrightii-Pinetum cubensis* in the pine forests of Cupeyal del Norte-La Munición

Inventory No.	1	2	3	Frec
Altitude (m.s.n.m.)	700	740	810	
Exposition	.	S	O	
Slope (degrees)	.	30	10	
E_3- Estrato arbóreo (cobertura %)	+	60	+	
E_2- Estrato arbustivo (%)	50	20	60	
E_1- Estrato herbáceo (%)	50	100	60	
E_0- Estrato muscinal (%)	10	20	40	
Nr. especies	71	47	56	58
Characteristic combination				
$E_{3,2}$- *Pinus cubensis* Griseb.	1	3	1	3(1-3)
E_3- *Jacaranda arborea* Urb.	1	r	1	3(r-1)
Tabebuia brooksiana Britton	1	r	r	3(r-1)
E_2- *Scaevola wrightii* (Griseb.) M. Gómez	1	2	1	3(1-2)
Baccharis scoparioides Griseb.	1	2	2	3(1-1)
Bactris cubensis Burret	r	+ø	1	3(r-1)
Koanophyllon polystictum (Urb.) R. M. King & H. Rob.	1	r	1	3(r-1)
Guettarda ferruginea C. Wright ex Griseb.	2	r	1	3(r-2)
Ilex macfadyenii (Walp.) Rehder subsp. *macfadyenii*	1	r	1	3(r-1)
Miconia echinata (Griseb.) Judd & al.	r	1	1	3(r-1)
Lepidaploa pineticola (Gleason) H. Rob.	2	1	2	3(1-2)
Guapira rufescens (Griseb.) Lundell	1	1	1	3(1)
Chamaecrista lineata (Sw.) Greene	1	1	1	3(1)
Coccothrinax orientalis (León) O. Muñiz & Borhidi	1	r	1	3(r-1)
E_1- *Paspalum rupestre* Trin.	2	2	2	3(2)
Rhynchospora tenerrima Nees ex Spreng.	2	2	2	3(2)
Scleria havanensis Britton	1	2	2	3(1-2)
E_0- *Cladonia* spp.	2	2	3	3(2-3)
L *Bisgoeppertia robustior* Greuter & R. Rankin	r	1	1	3(r-1)
Cynanchum sp.	1	r	1	3(r-1)
Stigmaphyllon sagranum A. Juss.	1	1	1	3(1)
Galactia rudolphioides (Griseb.) Benth. & Hook. f. ex Sauvalle	r	1	1	3(r-1)

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E_3- *Tabebuia dubia* (C. Wright) Britton ex Seibert	1	.	(+)	2(+-1)
E_2- *Oplonia spinosa* (Jacq.) Raf. subsp. *spinosa*	1	.	2	2(1-2)
Varronia longipedunculata Britton & P. Wilson	.	1	1	2(1)
Cyrilla nipensis Urb.	1	2	.	2(1-2)
Eugenia acrantha Urb.		1	1	2(1)
Guettarda valenzuelana A. Rich.	1	1	.	2(1)
Linodendron cubense (A. Rich.) Griseb.	1	.	1	2(1)
Garcinia ruscifolia (Griseb.) Borhidi	.	r	1	2(r-1)
Suberanthus canellifolius (Britton) Borhidi & M. Fernández	1	.	1	2(1)
Vaccinium cubense Griseb.	1	.	1	2(1)
Acrosynanthus latifolius Standl.	1	.	1	2(1)
Acrosynanthus parvifolius Britton	1	.	1	2(1)
Guettarda monocarpa Urb.	1	.	1	2(1)
Lyonia macrophylla (Britton) Ekman ex Urb.	1	1	.	2(1)
Lyonia affinis (A. Rich.) Urb.	.	1	r	2(r-1)
Malpighia sp.	r	.	1	2(r-1)
Miconia borhidiana Judd & al.	.	1	1	2(1)
Ouratea striata (Tiegh.) Urb.	.	1	1	2(1)
Psychotria revoluta DC.	1	1	.	2(1)
Psychotria thelephora Urb.	1	1	.	2(1)
Xylosma buxifolia A. Gray	1	1	.	2(1)
E_1 *Andropogon bicornis* L.	r	2	.	2(r-2)
Machaerina cubensis (Kük.) T. Koyama	2	.	r	2(r-2)
Ichnanthus mayarensis (C. Wright) Hitchc.	.	2	2	2(2)
Rhynchospora lindeniana Griseb.		2	2	2(2)
E_1- *Andropogon macrothrix* Trin.	r	2	.	2(r-2)
Bletia purpurea (Lam.) DC.	1	r	.	2(r-1)
H *Odontosoria aculeata* (L.) J. Sm.	2	.	1	2(1-2)
L *Arthrostylidium fimbriatum* Griseb.	2	.	1	2(1-2)
Smilax domingensis Willd.	.	1	1	2(1)
Vanilla poitaei Rchb. f.	.	r	r	2(r)

In a single inventory. Inv. 1: *Clusia rosea* Jacq. 1, *Plumeria obtusa* L. subsp. *obtusa* 1, *Euphorbia helenae* Urb. subsp. *helenae* 2, *Byrsonima cuneata* (Turcz.) P. Wilson +, *Calycogonium rosmarinifolium* Griseb. subsp.*rosmarinifolium* +, *Coccoloba diversifolia* Jacq. +, *Erythroxylum longipes* O. E. Schulz +, *Furcraea hexapetala* (Jacq.) Urb. +, *Marsdenia micrantha* Alain +, *Morella punctata* (Griseb.) J. Herb. +, *Neobracea valenzuelana* (A. Rich.) Urb. +, *Myrsine coriacea* (Sw.) R. Br. ex Roem. & Schult. +, *Antillanthus trichotomus* (Greenm.) B. Nord. +, *Lundinia plumbea* (Griseb.) B. Nord. +, *Tabebuia simplisifolia* Carabia ex Alain +, *Lepidaploa wrightii* (Sch. Bip.) H. Rob. +, *Rhynchospora scabrata* Griseb. +, *Scleria* sp. 1, *Cyathea parvula* (Jenman) Domin r, *Pteridium.caudatum* (L.) Maxon r, *Pecluma pectinata* (L.) M. G. Price +, *Passiflora nipensis* Britton +, *Dioscorea nipensis* R. A. Howard +, *Catopsis berteroniana* (Schult. & Schult. f.) Mez 1, *Prosthechea cochleata* (L.) W. E. Higgins +, *E. nocturnum* Jacq. +, *Tillandsia bulbosa* Hook. +, *T. fasciculata* Sw. r; Inv. 2: *Ovieda cubensis* (Schauer) I. E. Méndez r, *Dichanthelium laxiflorum* (Lam.) Gould 2, *Schizachyrium gracile* (Spreng.) Nash 1, *Callicarpa lancifolia* Millsp. r, *Schmidtottia shaferi* (Standl.) Urb. subsp. *shaferi* +, *Dendropemon lepidotus* (Krug & Urb.) Leiva & I. Arias subsp. *lepidotus* r; Inv. 3: *Casearia aquifolia* C. Wright +, *Croton monogynus* Urb. +, *Diospyros grisebachii* (Hiern) Standl. +, *Exostema purpureum* Griseb. subsp. *purpureum* +, *Gundlachia apiculata* Britton & S. F. Blake 2, *Gordonia wrightii* (Griseb.) H. Keng +, *Lyonia nipensis* Urb. subsp. *nipensis* +, *Miconia obtusa* (Griseb.) Triana +, *M. lenticellata* Alain +, *Phyllanthus mirificus* G.L. Webster 1, *Psychotrya lopezii* Acuña & Roig +, *Cassytha filiformis* L. +.

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DISCUSSION

Borhidi (1991) described the pine forests of the Sagua Baracoa Subregion within the class *Pinetea cubensis* and the order *Pinetalia cubensis*; in these the alliance *Guettardo ferrugineae-Pinion cubensis* Borhidi 1991 was presented, in which the pine forests of Cupeyal.

Later, Reyes and Acosta (2012) exposed within the same the suballiances *Cyrillo nipensis-Pinenion cubensis* (Reyes, 2012) where *Clidemio rubrinervis-Pinetum cubensis* is located and *Garcinio-Pinenion cubensis* (Reyes, 2012) where *Scaevolo wrightii-Pinetum cubensis* is considered.

Reyes and Acosta (2012) also reported that *Coccocypselo herbacei-Pinetum cubensis*, located in Piedra la Vela, is a relatively close association and is closely related to *Clidemio rubrinervis-Pinetum cubensis*, although it has lower altitude and rainfall.

Regarding the position of the different phytocenoses in the Cupeyal pine forests, it can be considered that *Clidemio rubrinervis-Pinetum cubensis typicum*, which occupied convex territories, is generally in contact with *Clidemio rubrinervis-Pinetum cubensis* homolepidetosum glutinosae, although it occasionally connected with *Scaevolo wrightii*-Pinetum cubensis; in turn *Clidemio rubrinervis-Pinetum cubensis homolepidetosum glutinosae*, which occurred in concave areas, often linked with submontane rainforests on offolites (Sensu Reyes, 2011-2012), mainly in depressions. The boundaries between the two sub-associations were relatively gradual, while the boundaries between *Clidemio rubrinervis-Pinetum cubensis typicum* and *Scaevolo wrightii-Pinetum cubensis* have been much more abrupt. The boundaries of the pine forests with the exposed rainforests were relatively sharp. As indicators of the humidity in homolepidetosum glutinosae can serve not only the presence or absence of the differential species, among them *Clusia rosea, Homolepis glutinosa* and *Coccocypselum herbaceum,* but also the vitality of some species such as the height of *Pteridium caudatum* and the presence of *Bactris cubensis*.

The areas where the pine forests have been totally degraded (calveros), were mainly covered by several species of the genus *Andropogon, Baccharis scoparioides* and *Pteridium caudatum* and were considered as one of the first stages of the succession. In these glades almost all the elements of the pinewoods were maintained, so no convergence was observed with those derived from other forest formations.

It should be noted that the abundance of *Baccharis scoparioides* and the other species mentioned above is due to repeated fires, which benefits species whose growth point is close to or within the soil and disadvantages shrubs that grow apically.

According to the observations made, the requirement for *Pteridium caudatum* in light in this area is obviously more evident in dry edaphotopes, while in relatively humid soils, this species (within the pine forests) is more tolerant of shade. This fact is important in forestry practice, especially in reforestation, both natural and artificial.

Scaevolo wrightii-Pinetum cubensis was considered an ecological equivalent, in this territory, of the other phytocenoses that make up *the Garcinio-Pinenion cubensis suballiance,* in which they have a rocky substrate and/or ferromagnetic brownish-red fersialytic soil (Hernández *et al.,* 2015), which although they have floristic peculiarities to determine that they are different associations have a similar structure, density of the shrub layer, xerophytic features, low presence of poaceae, abundance and diversity of species of the genus *Rhynchospora, fertility* and soil moisture.It was considered that the abundance of the muscinal depends on the competition with the other strata of the pine forest.

When comparing the associations of the Cupeyal pine forests, the influence of the ecotope on the characteristics and composition of the phytocenoses was clearly observed, while in *Clidemio rubrinervis-Pinetum cubensis* with better soil conditions there is greater floristic richness, in *Scaevolo wrightii-Pinetum cubensis*, where these conditions were more oligotrophic, dry and with less possibilities of radical development, there is greater endemism and more strict species of the subregion Sagua Baracoa.

Two well differentiated associations of pine forests were found: *Clidemio rubrinervis-Pinetum cubensis* and *Scaevolo wrightii-Pinetum cubensis*. The first one is found in dark red ferritic soils, deeper than the reddish-brown fersialis (ferromagnesial) where the second one develops.

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