The Rufford Small Grants Foundation

Final Report

Congratulations on the completion of your project that was supported by The Rufford Small Grants Foundation.

We ask all grant recipients to complete a Final Report Form that helps us to gauge the success of our grant giving. The Final Report must be sent in **word format** and not PDF format or any other format. We understand that projects often do not follow the predicted course but knowledge of your experiences is valuable to us and others who may be undertaking similar work. Please be as honest as you can in answering the questions – remember that negative experiences are just as valuable as positive ones if they help others to learn from them.

Please complete the form in English and be as clear and concise as you can. Please note that the information may be edited for clarity. We will ask for further information if required. If you have any other materials produced by the project, particularly a few relevant photographs, please send these to us separately.

Please submit your final report to jane@rufford.org.

Thank you for your help.

Josh Cole, Grants Director

Grant Recipient Details	
Your name	Lucia Hechavarria Schwesinger
Project title	The vascular epiphytes of Guamuhaya Mountainous Massif, Central Cuba: management strategies for its conservation in natural and agro-ecosystems.
RSG reference	10447-1
Reporting period	10/2011-12/2012
Amount of grant	5790 GBP
Your email address	lhechavarrias@yahoo.es
Date of this report	11/12/2012

1. Please indicate the level of achievement of the project's original objectives and include any relevant comments on factors affecting this.

Objective	**Not achieved**	**Partially achieved**	**Fully achieved**	**Comments**
To inventory vascular epiphyte species including endemism degree and conservation status			X	

To trace the management strategies for the long lasting conservation of vascular epiphytes in Guamuhaya massif			**X**	
To capacitate technical personnel and peasant of neighbouring communities of the protected areas			**X**	

2. Please explain any unforeseen difficulties that arose during the project and how these were tackled (if relevant).

3. Briefly describe the three most important outcomes of your project

1. Checklist of vascular epiphytes occurring in Guamuhaya range, Central Cuba

The inventory of vascular epiphytes in Guamuhaya Massif recorded 271 species, 88 genera and 23 plant families (Annex 1). Endemism degree is low ca. 12%, most of them are orchids. The 40% of the species have a global or local conservation status category, 24 species are considered threatened of them six are in critic endangered (CR), four endangered (EN) and eight near threatened (NT). The Gallery forests provide a suitable environment for vascular epiphytes (25spp.). Nevertheless, it's actual structure and mono specific composition of *Zizygium jambos* (Myrtaceae), an invasive plant, is probably the main risk of conservation of vascular epiphytic synusia in Guamuhaya gallery forests. The species produces allelopathic substances and transforms the original vegetation formation, and also exhibit a massive infection by *Roya,* an uredinal fungus. The Mogote Vegetation Complex (carsick heights) exhibit the vascular epiphyte major species richness in Guamuhaya. (Annex 2).

2**. Conservation action plan for vascular epiphytes in Guamuhaya range, Central Cuba**

A proposal of Action plan for the conservation of vascular epiphytes was elaborated (Annex 3). The action plan is structured in five main goals: 1) Revision of the actual knowledge state on vascular epiphytes; 2) Evaluation of vascular epiphytes natural populations; 3) Mapping important plant areas for the conservation of vascular epiphytes; In situ conservation of vascular epiphyte populations and 5) Environmental education. The activities proposed were identified in the different workshops developed in the present project.

3. **Capacity building of technical personnel and local communitarian people**

Technical personnel and peasants of the neighbouring communities were capacitated on recognition, conservation importance and sustainable use of vascular epiphytes in Guamuhaya range, Central Cuba. Through educational activities like talks, documental exhibition, promotional posters, identification photographic table guides and guided visits to ecological track in Lomas de Banao protected areas.

4. Briefly describe the involvement of local communities and how they have benefitted from the project (if relevant).

Local community was introduced in the topic of vascular epiphytes throughout talks, documental exhibition and different promotional material like posters and species identification table guides.

With special attention, we focused our work on women of Community "La 23", who are the main work force in the coffee plantations and that were very interested in the topic. We also developed guided visits to ecological tracks of the Ecological Reserve Lomas de Banao, where group of children from the neighboring communities' schools could learn with the first hand experience about vascular epiphytes and its important role as ecosystem functional species

5. Are there any plans to continue this work?

- To publish a book: "The vascular epiphytes of Guamuhaya. An illustrated guide of the prominent species" in order to increase the popular knowledge of this charismatic group of plants

- To start implementation of conservation action plan for vascular epiphytes in Guamuhaya (Objective 1)

-. To design a nursery (pilot project) to grow vascular epiphytes in Community "La 23", Guamuhaya range as a way to create new jobs, specially for women

- To continue with the environmental education using participative mechanisms in order to involve local people in the conservation of vascular epiphytes

6. How do you plan to share the results of your work with others?

- As an oral presentation in the XVII Congreso de la Sociedad Mesoamericana para la Biología y la Conservación. Palacio de las Convenciones de La Habana, 16-20 September, 2013.

- Throughout a scientific paper on Guamuhaya Vascular epiphytes checklist (endemism degree and conservation status)

- Throughout promotional materials on vascular epiphytes conservation

7. Timescale: Over what period was the RSG used? How does this compare to the anticipated or actual length of the project?

From 10/2011 until 12/2012, 18 months

8. Budget: Please provide a breakdown of budgeted versus actual expenditure and the reasons for any differences. All figures should be in £ sterling, indicating the local exchange rate used.

Item	Budgeted Amount	Actual Amount	Difference	Comments
Bank Transactions	5790	5550	240	Local exchange rate at September 9, 2011: 1 £ sterling = 1.48 CUC in Banco Metropolitano, La Habana, Cuba
Bus Tickets (5 persons/ 6 times)	900	890	10	
Fuel	400	410	-10	
Binocular (2)	140	136	4	
Diameter tape (2)	50	48	2	
Hand Pruner (2)	40	36	4	
Pruner kit (1)	110	112	-2	

Flagging roll (10)	20	20	0	
Professional digital camera (1)	600	590	10	
Camera batteries (2)	40	38	2	
Zoom Lens 400	750	961	-211	Price varied in the market
Camera memory cards (2)	40	56	-16	
Food	1100	990	110	
Batteries	50	50	0	
Power Inverter and Battery	120	100	20	
Desktop PC (1)	600	580	20	
Printer (1)	250	255	-5	
Printer toners (2)	80	92	-12	
Sheets (several formats)	50	50	0	
Posters and Photographic Table guides printing	450	350	100	Price varied in the market
Total	**5790**	5764	26	

9. Looking ahead, what do you feel are the important next steps?

- To apply to new funds to publish a book: "The vascular epiphytes of Guamuhaya. An illustrated guide of the prominent species" in order to increase the popular knowledge of this charismatic group of plants

- To start implementation of conservation action plan for vascular epiphytes in Guamuhaya (Objective 1)

10. Did you use the RSGF logo in any materials produced in relation to this project? Did the RSGF receive any publicity during the course of your work?

Yes, the RSG logo was used in promotional material of the Project, including presentations and printed materials (see Annex 4: Por qué conservar las epífitas, Annex 5: Helechos epifíticos comunes en Guamuhaya, Annex 6: Curujeyes (Bromeliaceae) en Guamuhaya

ANNEX 1

VASCULAR EPIPHYTES OCCURRING IN GUAMUHAYA MOUNTAINOUS MASSIF, CENTRAL CUBA. PRELIMINARY CHECKLIST

LUCIA HECHAVARRIA SCHWESINGER, LEDIS REGALADO GABANCHO & REINA ECHEVERRÍA CRUZ

The richness of vascular epiphytes occurring in the mountain range Guamuhaya, Central Cuba, comprises 271 species (Table 1), 88 genera and 23 plant families. Ferns are represented by 14 families, being Polypodiaceae (22), Hymenophyllaceae (17) and Aspleniaceae (13), the best represented. Most of the species are casual epiphytes and occurs in the first middle of the tree trunks (less than 1m). The flowering plants are represented by 9 families being Orchidaceae (98), Bromeliaceae (32) and Piperaceae (17) the best represented. Most of the species are holo-epiphytes (53,5%), followed by casual epiphytes (35,8%), climbers (Semi-epiphytes 5,5%) and hemi-epiphytes (4%). The endemic species are 32, most of them are orchids. Only 40% of the species have a global or local conservation status category, 24 species are considered threatened of them 6 are in critic endangered (CR), 4 endangered (EN) and 8 near threatened (NT). The Gallery forests and the Mogotes (carsick heights) are the natural ecosystems with biggest species richness. The best represented agro-ecosystem is the Coffee Plantations, where vascular epiphytes colonized the trees used as shadow for the coffee plants as *Samanea samans* (Leguminosae), species that provide a suitable environment for epiphytes, commonly used by the farmers.

LITERATURE CITED

Berazaín, R., F. Areces, J. C. Lazcano & L. R. González. 2005. Lista Roja de la Flora Vacular Cubana. Jardín Botánico Atlántico, Guijón. 86pp.

González-Torres L. R., R. Rankin Rodríguez, A. T. Leiva Sánchez & A. Palmarola Bejerano. 2008. Categorización preliminar de taxones de la flora de Cuba-2008. Bissea 2 (número especial): 1-77.

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The Plant List **(2010). Version 1. Published on the Internet; http://www.theplantlist.org/ (accessed 15 May, 2012).**

Table 1: Preliminary checklist of vascular epiphytes occurring in Guamuhaya mountainous massif, Central Cuba. Scientific names updated according to www.theplantlist.org, endemic species are in bold. Preliminary Conservation status (González *et al*. 2008, 2009), in parenthesis the actual IUCN red list category (Berazaín *et al.* 2005): Threatened species (T): (1) taxon populations are small (<10 000 mature individuals),(2) the taxon is distributed in small regions (presence extension < 20 000 km2), (3) taxon populations diminished in a 50% or more in the last 10 years, (4) taxon populations severed fragmented in the last 10 years or are only occurring in less than 10 localities. Near Threatened (NT): (1) if it is predicted that taxon populations could diminish in a 50% or more in the next 10 years (2) if it is predicted that taxon populations could be severed fragmented in the next 10

years. Low Concern(LC): (1) taxon populations are large (>10 000 mature individuals), (2) taxon occurs in large regions (> 20 000km2), (3) if it is not predicted the taxon populations could diminished in a 50% or more in the next 10 years (4) if it is not predicted that taxon populations could be severed fragmented in the next 10 years. Deficient Data (DD): if there is no enough or reliable data for the preliminary evaluation of the taxon. Taxon no evaluated (NE).

Plant Family	Scientific Name	Conservation status	Habit
Araceae	**Anthurium gymnopus Griseb.**	T (CR)	Holo-epiphytic
	Philodendron consanguineum Schott	LC	Semi-epiphytic (climber)
	Philodendron hederaceum (Jacq.) Schott	LC	Semi-epiphytic (climber)
	Philodendron lacerum (Jack.) Schott	LC	Semi-epiphytic (climber)
Aspleniaceae	Asplenium abscissum	LC	Casual epiphytic
	Asplenium auriculatum Sw.	LC	Casual epiphytic
	Asplenium auritum Sw.	LC	Casual epiphytic
	Asplenium cristatum	LC	Casual epiphytic
	Asplenium cuneatum Lam.	LC	Holo-epiphytic
	Asplenium diplosceum Hieron.	LC	Casual epiphytic
	Asplenium erosum	LC	Casual epiphytic
	Asplenium jenmanii Proctor	NT	Casual epiphytic
	Asplenium juglandifolium Lam.	LC	Holo-epiphytic
	Asplenium monodon Liebm.	LC	Casual epiphytic
	Asplenium myriophyllum (Sw.) K. Presl	LC	Casual epiphytic
	Asplenium rectangulare Maxon	T (CR)	Holo-epiphytic
	Asplenium rhomboidale Desv.	T (EN)	Holo-epiphytic
	Asplenium salicifolium L.	LC	Casual epiphytic
	Asplenium serratum L.	LC	Casual epiphytic
Begoniaceae	**Begonia banaoensis J. Sierra**	NE	Casual epiphytic
	Begonia glabra var glabra Aubl.	T (V)	Casual epiphytic
Blechnaceae	Blechnum fragile (Liebm.) C. V. Morton & Lellinger	LC	Hemi-epífita
Bromeliaceae	Aechmea nudicaulis (L.) Griseb.	LC	Casual epiphytic
	Catopsis berteroniana (Schult. & Schult.f.) Mez	LC	Holo-epiphytic
	Catopsis floribunda L.B. Sm.	LC	Holo-epiphytic
	Catopsis nitida (Hook.) Griseb.	NT	Holo-epiphytic
	Catopsis nutans (Sw.) Griseb. var nutans	LC	Holo-epiphytic
	Guzmania lingulata (L.) Mez var. lingulata	NT	Holo-epiphytic
	Guzmania monostachia (L.) Rusby ex Mez var monostachia	LC	Holo-epiphytic
	Guzmania monostachia var alba Ariza-Julia	T	Holo-epiphytic
	Guzmania monostachia var rosea nsp	T	Holo-epiphytic
	Guzmania monostachia var variegata hort. ex Nash	T	Holo-epiphytic
	Hohenbergia penduliflora (A. Rich.) Mez	LC	Holo-epiphytic
	Tillandsia argentea Griseb.	T	Holo-epiphytic
	Tillandsia balbisiana Schult. f.	LC	Holo-epiphytic
	Tillandsia bulbosa Hook.	LC	Holo-epiphytic
	Tillandsia butzii Mez	T	Holo-epiphytic

	Tillandsia clavispica Mez	LC	Holo-epiphytic
	Tillandsia deppeana Steud. var. deppeana	T	Holo-epiphytic
	Tillandsia festucoides Brongn.	LC	Holo-epiphytic
	Tillandsia flexuosa Sw.	LC	Holo-epiphytic
	Tillandsia juncea (Ruiz & Pav.) Poiret	LC	Casual epiphytic
	Tillandsia paucifolia Baker	LC	Holo-epiphytic
	Tillandsia polystachia (L.) L.	LC	Holo-epiphytic
	Tillandsia pruinosa Sw.	LC	Holo-epiphytic
	Tillandsia recurvata (L.) L.	LC	Casual epiphytic
	Tillandsia schiedeana Steud.	LC	Holo-epiphytic
	Tillandsia setacea Sw.	LC	Holo-epiphytic
	Tillandsia tenuifolia L.	LC	Holo-epiphytic
	Tillandsia tephrophylla Harms	NT	Holo-epiphytic
	Tillandsia uncispica Mez	LC	Holo-epiphytic
	Tillandsia usneoides L.	LC	Holo-epiphytic
	Tillandsia utriculata L. var utriculata	NT	Holo-epiphytic
	Tillandsia variabilis Schlecht.	LC	Holo-epiphytic
	Vriesea ringens (Griseb) Harms	LC	casual epiphytic
Cactaceae	Rhipsalis baccifera (J. S. Muell.) Stearn subsp. baccifera	LC	Holo-epiphytic
	Selenicereus boeckmannii (Otto ex Salm-Dyck) Britton & Rose	LC	Secondary Hemi-epiphytic
	Selenicereus brevispinus Britton & Rose	T (EN)	Secondary Hemi-epiphytic
	Selenicereus grandiflorus (L.) Britton & Rose	LC	Secondary Hemi-epiphytic
	Selenicereus urbanianus (Gurke & Weing.) Britton & Rose	LC	Secondary Hemi-epiphytic
Clusiaceae	Clusia minor L.	LC	Primary Hemi-epiphytic
	Clusia rosea M. Jacq.	LC	Primary Hemi-epiphytic
Dryopteridaceae	Arachniodes chaerophylloides (Poir.) Proctor	LC	Casual epiphytic
Dryopteridaceae	**Arachniodes chaerophylloides var sericea Christ**	DD	Casual epiphytic
Dryopteridaceae	Arachniodes pubescens (L.) Proctor	DD	Casual epiphytic
	Elaphoglossum chartaceum (Baker ex Jenman) C. Chr.	LC	Casual epiphytic
	Elaphoglossum cubense (Mett. ex Kunhn) C. Chr.	LC	Casual epiphytic
	Elaphoglossum gramineum (Jenman) Urb.	LC	Casual epiphytic
	Elaphoglossum herminieri (Bory ex Fée) T. Moore	LC	Holo-epiphytic
	Elaphoglossum maxonii Underw. ex C. V. Morton	DD	Holo-epiphytic
	Elaphoglossum palmeri Underw. & Maxon	LC	Holo-epiphytic
	Elaphoglossum procurrens (Mett. Ex D. C. Eaton) Moore	LC	Casual epiphytic
	Elaphoglossum raywaense (Jenman) Alston	LC	Casual epiphytic
	Elaphoglossum revolutum (Liebm.) T. Moore	DD	Casual epiphytic
	Elaphoglossum simplex (Sw.) Schott ex J. Sm.	DD	Holo-epiphytic
	Maxonia apiifolia (Sw.) C. Chr.	T (CR)	Casual epiphytic
	Olfersia cervina (L.) Kunze	LC	Casual epiphytic
	Polybotria osmundacea Humb. & Bonpl. Ex Willd.	LC	Hemi-epífita

	Rumohra adiantiformis (G. Forst.) Ching	NT	Holo-epiphytic
Grammitidaceae	Cochlidium serrulatum (Sw.) L. E. Bishop	DD	Holo-epiphytic
	Lellingeria delitescens (Maxon) A. R. Sm. & R. C. Moran	DD	Holo-epiphytic
	Hymenophyllum darwinii Hook. F. ex Bosch	NT (LC)	Holo-epiphytic
	Hymenophyllum hirsutum (L.) Sw.	LC	Holo-epiphytic
	Hymenophyllum polyanthos (Sw.) Sw.	LC	Holo-epiphytic
	Sphaerocionium hirtellum (Sw.) C. Presl	T (CR)	Holo-epiphytic
	Trichomanes angustatum Carmich.	LC	Casual epiphytic
	Trichomanes capillaceum L.	LC	Casual epiphytic
	Trichomanes crispum L.	LC	Casual epiphytic
	Trichomanes holopterum Kunze	LC	Casual epiphytic
	Trichomanes hymenophylloides Bosch	LC	Casual epiphytic
	Trichomanes kapplerianum J. W. Sturm	T (LC)	Casual epiphytic
	Trichomanes krausii Hook. & Grev.	LC	Casual epiphytic
	Trichomanes lineolatum (Bosch) Hook.	LC	Casual epiphytic
	Trichomanes membranaceum L.	LC	Casual epiphytic
	Trichomanes padronii Proctor	T (CR)	Holo-epiphytic
	Trichomanes polypodioides L.	LC	Holo-epiphytic
	Trichomanes punctatum subsp. Sphenoides (Kunze) Wess. Boer	LC	Casual epiphytic
	Trichomanes speciosum Willd.	LC	Holo-epiphytic
Lomariopsidaceae	Lomariopsis kunzeana (Underw.) Holttum	DD	Hemi-epífita
Lycopodiaceae	Huperzia acerosa (Sw.) Holub	DD	Holo-epiphytic
	Huperzia dichotoma (Jacq.) Trevis.	DD	Holo-epiphytic
	Huperzia funiformis (Cham ex Spring.) Trevis	DD	Holo-epiphytic
	Huperzia linifolia (L.) Trevis.	DD	Holo-epiphytic
	Huperzia taxifolia (Sw.) Trevis.	DD	Holo-epiphytic
Marcgraviaceae	**Marcgravia evenia Krug & Urb.**	NE	Semi-epiphytic (climber)
	Marcgravia trinitatis C. Presl	NE	Semi-epiphytic (climber)
Moraceae	Ficus americana Aubl.	NE	Primary Hemi-epiphytic
	Ficus aurea Nutt	NE	Primary Hemi-epiphytic
	Ficus citrifolia Mill.	NE	Primary Hemi-epiphytic
	Ficus membranacea C. Wright	NE	Primary Hemi-epiphytic
	Ficus trigonata L.	NE	Primary Hemi-epiphytic
Nephrolepidaceae	Nephrolepis biserrata (Sw.) Schott	NE	Casual epiphytic
	Nephrolepis cordifolia (L.) C. Presl	NE	Casual epiphytic
	Nephrolepis exaltata (L.) Schott	NE	Casual epiphytic
	Nephrolepis hirsutula (G. Forst.) C. Presl)	NE	Casual epiphytic
	Nephrolepis pectinata (Willd.) Schott	NE	Casual epiphytic
	Nephrolepis rivularis (Vahl) C. Chr.	NE	Casual epiphytic
Oleandraceae	Oleandra articulata (Sw.) C. Presl Nomenclatura sin resolver	NE	Casual epiphytic
Ophioglossaceae	Ophioglossum palmatum (L.) C. Presl	LC	Holo-epiphytic
Orchidaceae	Acianthera angustifolia (Lindl.) Luer	NE	Casual epiphytic
	Anathallis sertularioides (Sw.) Pridgeon & M. W. Chase	T (LC)	Holo-epiphytic
	Brassia caudata (L.) Lindl.	NE	Casual epiphytic
	Bulbophyllum aristatum (Rchb. fil.) Hemsl.	NE	Holo-epiphytic

	Bulbophyllum pachyrachis (A. Rich.) Griseb.	NE	Holo-epiphytic
	Camaridium vestitum (Sw.) Lindl.	NE	Holo-epiphytic
	Campylocentrum fasciola (Lindl.) Cogn.	NE	Holo-epiphytic
	Campylocentrum pachyrrhizum (Rchb. F.) Rolfe	NE	Holo-epiphytic
	Campylocentrum poeppigii (Rchb. f.) Rolfe	NE	Holo-epiphytic
	Cochleanthes discolor (Lindl.) R. E. Schultes & Garay	NE	Holo-epiphytic
	Cochleanthes flabelliformis (Sw.) R. E. Schult. & Garay	NE	Casual epiphytic
	Coelia triptera (Sm.) G. Don ex Steud	NE	Holo-epiphytic
	Comparettia falcata Poepp. & Endl.	NE	Holo-epiphytic
	Cyrtopodium punctatum (L.) Lindl.	NE	Holo-epiphytic
	Dendrophylax gracilis (Cogn.) Garay	NE	Holo-epiphytic
	Dendrophylax lindenii (Lindl.) Benth. Ex Rolfe	NE	Holo-epiphytic
	Dendrophylax varius (J. F. Gmel.) Urb.	NE	Holo-epiphytic
	Encyclia bipapularis (Rchb.f.) Acuña	NE	Holo-epiphytic
	Encyclia fucata (Lindl.) Britton & Millsp.	NE	Holo-epiphytic
	Encyclia nematocaulon (A.Rich.) Acuña	T (CR)	Holo-epiphytic
	Encyclia oncidioides (Lindl.) Schltr.	NE	Holo-epiphytic
	Encyclia oxypetala (Lindl.) Schltr.	NE	Holo-epiphytic
	Encyclia phoenicea (Lindl.) Newman	NE	Holo-epiphytic
	Encyclia plicata (Lindl.) Schltr.	NE	Holo-epiphytic
	Encyclia rufa (Lindl.) Britton & Millsp.	NE	Holo-epiphytic
	Epidendrum anceps Jacq.	NE	Casual epiphytic
	Epidendrum blancheanum Urb.	NE	Holo-epiphytic
	Epidendrum difforme Jacq.	NE	Holo-epiphytic
	Epidendrum diffusum Sw.	NE	Holo-epiphytic
	Epidendrum floridense Hágsater	NE	Holo-epiphytic
	Epidendrum jamaicense Lindl.	NE	Holo-epiphytic
	Epidendrum nocturnum Jacq.	NE	Holo-epiphytic
	Epidendrum ramosum Jacq.	NE	Holo-epiphytic
	Epidendrum rigidum Jacq.	NE	Holo-epiphytic
	Epidendrum secundum Jacq.	NE	Holo-epiphytic
	Epidendrum umbellatum Sw.	NE	Holo-epiphytic
	Epidendrum verrucosum Sw.	NE	Holo-epiphytic
	Epidendrum wrightii Lindl.	NE	Casual epiphytic
	Eurystyles ananassocomus (Rchb. fil.) Schltr.	DD	Holo-epiphytic
	Heterotaxis sessilis (Sw.) F. Barros	NE	Holo-epiphytic
	Heterotaxis valenzuelana (A. Rich.) Ojeda & Carneval	NE	Holo-epiphytic
	Ionopsis utricularioides (Sw.) Lindl.	NE	Holo-epiphytic
	Isochilus linearis (Jacq.) R. Br.	NE	Casual epiphytic
	Jacquiniella globosa (Jacq.) Schltr.	NE	Casual epiphytic
	Jacquiniella teretifolia (Sw.) Britton & P. Wils.	NE	Casual epiphytic
	Leochilus labiatus (Sw.) Kuntze	NE	Holo-epiphytic
	Leochilus scriptus (Scheidw.) Rchb. f.	NE	Holo-epiphytic
	Lepanthes dorsalis Lindl.	NE	Holo-epiphytic

	Lepanthes dresslerii Hespenh.	NE	Holo-epiphytic
	Lepanthes melanocaulon Schltr.	NE	Holo-epiphytic
	Lepanthes obliquiloba Hespenh.	NE	Holo-epiphytic
	Lepanthes obliquipetala Hespenh.	NE	Casual epiphytic
	Lepanthes occidentalis Hespenh.	NE	Holo-epiphytic
	Lepanthes trichodactyla Lindl.	T (EN)	Casual epiphytic
	Lepanthopsis anthoctenium (Rchb.f.) Ames	NE	Holo-epiphytic
	Lepanthopsis melanantha (Rchb. fil.) Ames	DD	Holo-epiphytic
	Lepanthopsis microlepanthes (Griseb.) Ames	T (EN)	Holo-epiphytic
	Lepanthopsis pygmaea C. Schweinf.	T	Holo-epiphytic
	Liparis nervosa (Thunb.) Lindl.	NE	Holo-epiphytic
	Macradenia lutescens R. Br.	NE	Holo-epiphytic
	Nidema ottonis (Rchb. fil.) Britton & Millsp.	NE	Holo-epiphytic
	Pleurothallis trichophora Lindl.	NE	Holo-epiphytic
	Polystachya concreta (Jacq.) Garay & H. R. Sweet	NE	Holo-epiphytic
	Prosthechea boothiana (Lindl.) Dressler	NE	Holo-epiphytic
	Prosthechea cochleata (L.) Dressler	NE	Casual epiphytic
	Prosthechea pygmaea (Hook) W.E.Higgins	NE	Casual epiphytic
	Prosthechea vespa (Vell.) W. E. Higgins	NE	Holo-epiphytic
	Specklinia brighamii (S. Watson) Pridgeon & M. W. Chase	T	Holo-epiphytic
	Specklinia corniculata (Sw.) Steud.	LC	Holo-epiphytic
	Specklinia grisebachiana (Cogn.) Luer	T	Holo-epiphytic
	Specklinia grobyi (Bateman ex Lindl.) F. Barros	NE	Holo-epiphytic
	Specklinia tribuloides (Sw.) Pridgeon & M. W. Chase	LC	Holo-epiphytic
	Spiranthes torta (Thunb.) Garay & H. R. Sweet.	NE	Holo-epiphytic
	Stelis gelida (Lindl.) Pridgeon & M. W. Chase	T	Holo-epiphytic
	Stelis multirostris (Rchb. F.) Pridgeon & M. W. Chase	NE	Holo-epiphytic
	Stelis quadrifida (Lex.) Solano & Soto Arenas	T	Holo-epiphytic
	Stenorrhynchos speciosum (Jacq.) L. C. Rich.	NE	Holo-epiphytic
	Sudamerlycaste barringtoniae (Sm.)	**NE**	Holo-epiphytic
	Tolumnia calochila (Cogn.) Braem	NT	Holo-epiphytic
	Tolumnia guianensis (Aubl.) Braem	NE	Holo-epiphytic
	Tolumnia guttata (L.) Nir	NE	Holo-epiphytic
	Tolumnia leiboldii (Rchb. f.) Braem	NE	Holo-epiphytic
	Tolumnia lucayana (Nash) Braem.	NE	Holo-epiphytic
	Tolumnia variegata (Sw.) Braem	NE	Holo-epiphytic
	Tolumnia x cubense (Moir) H. Dietr.	NE	Holo-epiphytic
	Trichocentrum luridum (Lindl.) M. W. Chase & N. H. Williams	NE	Holo-epiphytic
	Trichocentrum undulatum (Sw.) Ackerman & M. W. Chase	NE	Holo-epiphytic
	Trichosalpinx dura (Lind.) Luer	T	Holo-epiphytic
	Trichosalpinx memor (Rchb. f.) Luer	T	Holo-epiphytic
	Tropidia polystachya (Sw.) Ames	NE	Holo-epiphytic
	Vanilla barbellata Rchb. f.	NE	Semi-epiphytic (climber)

	Vanilla bicolor Lindl.	NE	Semi-epiphytic (climber)
	Vanilla dilloniana Correll	NE	Semi-epiphytic (climber)
	Vanilla mexicana Mill.	NE	Semi-epiphytic (climber)
	Vanilla palmarum (Salzm. ex Lindl.) Lindl.	NE	Semi-epiphytic (climber)
	Vanilla phaeantha Rchb. f.	LC	Semi-epiphytic (climber)
	Vanilla planifolia Jacks. Ex Andrews	NE	Semi-epiphytic (climber)
	Vanilla poitaei Rchb. f.	NE	Semi-epiphytic (climber)
	Zootrophion atropurpureum (Lindl.) Luer	T	Holo-epiphytic
Piperaceae	Peperomia crassicaulis Fawc. & Rendle	NE	Casual epiphytic
	Peperomia distachya (L.) A. Dietr.	NE	Casual epiphytic
	Peperomia emarginella (Sw. Ex Wikstr.) C. DC.	NE	Casual epiphytic
	Peperomia glabella (Sw.) A. Dietr. var glabella	NE	Semi-epiphytic (climber)
	Peperomia glabella var nervulosa (C. DC.) Yunck.	NE	Casual epiphytic
	Peperomia grisebachii C. DC.	NE	Casual epiphytic
	Peperomia guadaloupensis C. DC.	NE	Casual epiphytic
	Peperomia maculosa (L.) Hook.	NE	Casual epiphytic
	Peperomia magnoliifolia (Jacq.) A. Dietr.	NE	Casual epiphytic
	Peperomia obtusifolia (L.) A. Dietr. var obtusifolia	NE	Casual epiphytic
	Peperomia obtusifolia var emarginata (Ruiz & Pav.) Dahlst	NE	Casual epiphytic
	Peperomia quadrangularis (J. V. Thomps.) A. Dietr.	NE	Casual epiphytic
	Peperomia quadrifolia (L.) Kunth	NE	Casual epiphytic
	Peperomia rhombea Ruiz & Pav.	NE	Casual epiphytic
	Peperomia rotundifolia (L.) Kunth	NE	Casual epiphytic
	Peperomia septemnervis Ruiz & Pav.	NE	Casual epiphytic
	Peperomia serpens (Sw.) Loudon	NE	Casual epiphytic
	Peperomia tetraphylla (G. Forst.) Hook. & Arn.	NE	Casual epiphytic
Polypodiaceae	Campyloneurum angustifolium (Sw.) Fée	NE	Casual epiphytic
	Campyloneurum brevifolium (Lodd. Ex Link) Link	NE	Casual epiphytic
	Campyloneurum costatum (Kunze) C. Presl	NE	Holo-epiphytic
	Campyloneurum phyllitidis (L.) C. Presl	NE	Casual epiphytic
	Microgramma heterophylla (L.) Wherry	NE	Holo-epiphytic
	Microgramma lycopodioides (L.) Copel.	NE	Casual epiphytic
	Microgramma piloselloides (L.) Copel.	NE	Casual epiphytic
	Niphidium crassifolium (L.) Lellinger	NE	Casual epiphytic
	Pecluma dispersa (A. M. Evans) M. G. Price	NE	Casual epiphytic
	Pecluma pectinata (L.) M. G. Price	NE	Casual epiphytic
	Pecluma plumula (Humb. & Bonpl. ex Willd.) M. G. Price	NE	Casual epiphytic
	Phlebodium areolatum (Humb. & Bonpl. ex Willd.) J. Sm.	NE	Casual epiphytic
	Phlebodium aureum (L.) J. Sm.	NE	Casual epiphytic
	Phlebodium pseudoaureum (Cav.) Lellinger	NE	Casual epiphytic
	Pleopeltis astrolepis (Liebm.) E. Fourn.	NE	Holo-epiphytic
	Pleopeltis polypodioides (L.) E. G. Andrews & Windham	NE	Holo-epiphytic

	Pleopeltis squamata (L.) J. Sm.	NE	Holo-epiphytic
	Polypodium dulce Poir.	NE	Casual epiphytic
	Polypodium loriceum L.	NE	Casual epiphytic
	Polypodium subpetiolatum Hook.	NE	Casual epiphytic
	Serpocaulon triseriale var. gladiatum (Khun) Proctor	NE	Casual epiphytic
	Serpocaulon triseriale (Sw.) A. R. Sm.	NE	Holo-epiphytic
	Terpsichore mollissima (Fée) A. R. Sm.	NE	Holo-epiphytic
Psilotaceae	Psilotum nudum (L.) P. Beauv.	LC	Casual epiphytic
Rubiaceae	Hillia tetrandra Sw.	LC	Casual epiphytic
Selaginellaceae	Selaginella tenuissima Fée	NE	Casual epiphytic
Urticaceae	Pilea nummulariifolia (Sw.) Wedd.	NE	Semi-epiphytic (climber)
	Pilea pubescens Liebm.	NE	Casual epiphytic
Vittariaceae	Ananthacorus angustifolius (Sw.) Underw. & Maxon	NE	Casual epiphytic
	Antrophyum intramarginale (Baker ex Jenman) Kartesz & Gandhi	NE	Holo-epiphytic
	Polytaenium feei (W. Schaffn. ex Fée) Maxon	NE	Holo-epiphytic
	Polytaenium lineatum (Sw.) J. Sm.	NE	Casual epiphytic
	Radiovittaria stipitata (Kunze) E. H. Crane	NE	Casual epiphytic
	Vittaria graminifolia Kaulf.	NE	Holo-epiphytic
	Vittaria lineata (L.) Sm.	NE	Holo-epiphytic

ANNEX 2

MACRO AND MICROHABITAT CHARACTERIZATION OF VASCULAR EPIHYTE SYNUSIA AT MOGOTE LA SABINA, ECOLOGICAL RESERVE LOMAS DE BANAO, GUAMUHAYA, CENTRAL CUBA

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INTRODUCTION

Epiphytes contribute significantly to the diversity and abundance of tropical flora (Nieder *et al*.1996-97), and make up about 10% of the vascular flora of the planet (Kress 1986). In Cuba, the 5,1% of angiosperms (Hechavarría *et al.* 2002), and over 36% of pteridophytes (Sánchez pers. Comm[1].), exhibit this habit in all its variants (Kress 1986). Epiphytes representation is not only important from the taxonomic point of view, but also as plant community point of view. Braun-Blanquet (1979) considers epiphytes as a distinct floristic synusia, ecologically dependent of the multi-layered community in which it is established, a community with high organizational degree that conditions the climate where they thrive. According to this author, the presence of epiphytic communities could be considered as indicator of stable and balanced habitat.

In Guamuhaya, the karst vegetation complex "Mogotes *s.l.*" (MVC), characterized by shrub vegetation and discontinued deciduous arboreal strata of 5-10 m height, with the presence of palms,

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succulent plants, and abundant epiphytes and lianas, which forms a complex of vegetation with deciduous and evergreen forests (Berazaín & Capote 1984), is one of the most common plant formation at mountains top. This mosaic of vegetation develops on limestone rocks, which is considered one of the most important geological and soil factors that influences the richness and endemism of our flora (Muñiz 1970).
How varies the composition and abundance of vascular epiphytes in the MVC? How varies the structure and vegetation composition (macrohabitat conditions) where vascular epiphyte synusia inhabit at MVC? How varies the host tree they colonized according to: Diameter at breast hight (DBH), vertical distribution, colonized substrate and light condition (microhabitat condition) in the MVC. To conduct a field work to answer these questions we choose the Mogote La Sabina, at the Ecological Reserve Lomas de Banao, Sancti Spiritus, Guamuhaya mountain range, Central Cuba.

Study area: Mogote La Sabina, Ecological Reserve Lomas de Banao, Central Cuba

The Mogote "La Sabina", located at 21°53'16''N and 79°36'08''W, at 500 m from the Biological Station of the same name in the Ecological Reserve Lomas de Banao, is a karstick hight of 600-700 m altitude (Photo 1).

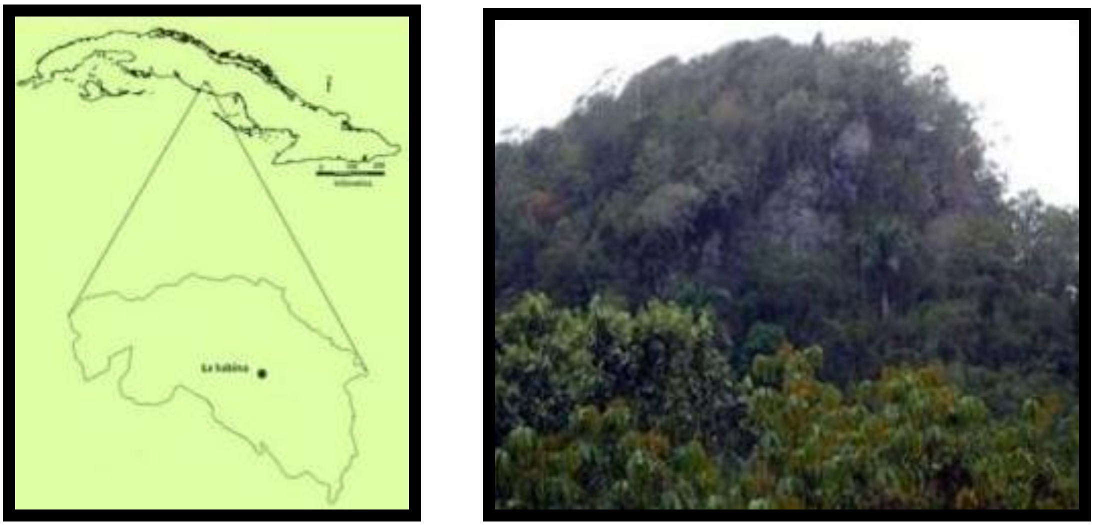

Photo 1: The Mogote La Sabina, Ecological Reserve Alturas de Banao, Guamuhya, Central Cuba

The relief is composed by carbonate schist where develops a reddish-brown rendzina soil, rich in organic material. On the cliff top the predominant vegetation type is a shrub wood which forms the complex with the mesophyllous evergreen forest of the side slopes. Climate conditions are the following (Perez 1999): annual average temperature is 22° C, annual rainfall average: 1400-1800 mm.

Material and Methods

The sample size was determined using the minimal area method (Krebs 1989), where trees with DBH over 2cm, with epiphytes (phorophyte) or not, were selected randomly, in plots of 180 m^2 (6 x 30 m) having in count the patch distribution pattern of epiphytes. There were located on Top (shrub wood), North and South slopes of Mogote (evergreen forest).

We performed a floristic inventory per plot (species composition) and recorded the number of individuals per species. Plants that could not be identified "*in situ*" were collected for determination in the Herbarium of the Academy of Sciences (HAC), at the Institute of Ecology and Systematic (IES). Epiphytic species were identified combining the methods of remote monitoring and direct observation only in extreme cases to prevent damage to the epiphyte community in the sampled tree (Hietz & Wolf 1996). For remote monitoring were used binoculars (7x20) and at least were observed from two points (Migenis & Ackerman 1993).

Macrohabitat characterization: Vegetation structure and composition

To characterize the macrohabitat *sensu* Morrison *et al.* (1998), analyze was based on the structure and composition of vegetation the epiphytic synusia inhabit in the MVC, we measured the following parameters:

1. Mean canopy height (qualitative assessment): We estimated the average height of the dominant arboreal layer.
2. Canopy cover: The percentage of coverage was determined by James & Shugart (1970), observed through a plastic cylinder 43 mm in diameter at its distal end divided into four quadrants. Five observations were made, one every five meters along the plot, for a total of 35 points which were then averaged. This parameter was measured in dry season.
3. Undergrowth density: Measurements were made in the dry season to three heights: DS1 = 0 - 0.3 m, DS2 = 0.3-1.0 m DS3 = 1.0-2.0 m, and using a panel of density (James & Shugart 1970) counting the panel boxes covered over 50% of its area. Measurements were made every five meters along the plot. The first two measurements were made from a squatting position to avoid parallelism.
4. Rockiness: The percentage of rockiness was determined using the same method used to assess canopy cover, but considering as positive the presence of rocks on the ground.
5. Plant density: Number of individuals per species in each plot
6. Diameter at breast height of the tree trunk (1.30 m, DBH): were measured in every selected tree, using a 10 m diameter tape, and analyzed by classes (Migenis & Ackerman 1993). In the mogote tope the shrub vegetation is the predominant, so this parameter was measured at the selected branch (Bøgh 1993), to avoid loss of information and to do statistically comparable the data taken.
   - Class 1: 2.5 <Ø <4.0 cm
   - Class 2: 4.1 <Ø <6.0 cm
   - Class 3: 6.1 <Ø <10.0 cm
   - Class 4: 10.1 <Ø <16.0 cm
   - Class 5: Ø> 16.1 cm

   A nonparametric Linear Regression Analysis was performed to verify if the variation in the number of host trees regarding those that not were colonized by epiphytes is linear with increasing of DBH.
7. Bark type: we established two classes: smooth bark (SB) and rough bark (RB; Migenis & Ackerman 1993). This parameter was measured in trees and shrubs.

To analyze the influence of each parameter on epiphytic species richness per vegetation we used the nonparametric correlation test of Spearman ranks.

Epiphytes Microhabitat characterization

To characterize the microhabitat *sensu* Morrison et al. (1998), we based the approach in the evaluation of the following variables:

1. Vertical distribution pattern (Fig. 1): Zone 1 (lower half of the trunk), Zone 2 (upper trunk), Zone 3 (primary branches), Zone 4 (secondary branches), Zone 5 (and tertiary branches other higher orders). For shrubs, Zone 2 was eliminated in those branched almost from the base of the trunk. For vines with epiphytes, this parameter was not taken into account.

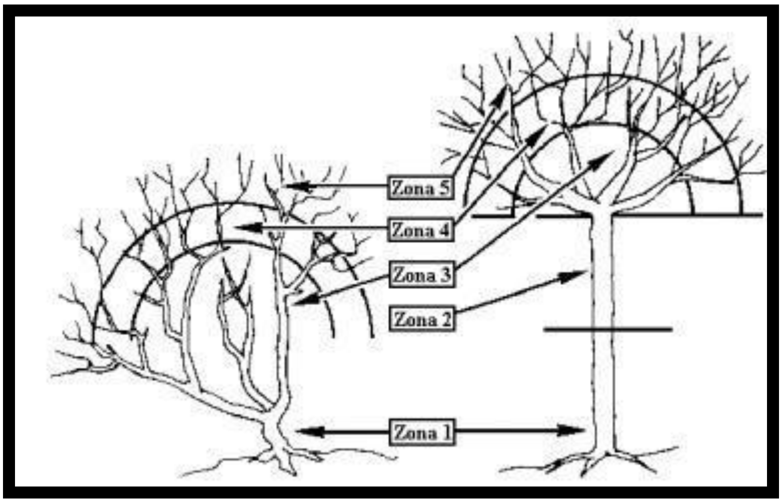

Figure 1: Vertical distribution pattern of epiphytes (Zone 1: trunk inferior half; Zone 2: trunk superior half; Zone 3: primary branches; Zone 4: secondary branches; Zone 5: tertiary branches and superior orders). Taken and modified from Bøgh (1993).

1. Surrounding Lighting (qualitative assessment) established three basic types: Shadow (S), filtered light (FL); individuals receiving the light filtering through the foliage and Direct Light (DL).
2. Type of substrate: bark and accumulation of organic matter in soil or host (Humus).

RESULTS AND DISCUSSION

Epiphyte sinusia of Mogote La Sabina

Epiphyte sinusia composition in the Mogote La Sabina vegetation complex comprises 37 species, 24 genera and 12 plant families (table 1). Families Orchidaceae (11spp.) and Bromeliaceae (9spp) are the best represented, followed by the fern family Polypodiaceae (4spp).

Table 1: Vascular epiphyte species present at Mogote la Sabina Vegetation Complex. Relative abundance per species at Shrub thicket (Top), North Slope Evergreen Forest (N_Slope) and South Slope Evergreen Forest (S_slope) and epiphyte category (E_category: H: holoepiphyte; CE: Casual epiphyte; 1HE: Primary hemi-epiphyte; 2HE: Secondary hemi-epiphyte; C: Climber

Taxa per plant family	Relative abundance (%)			
	Top	N_Slope	S_slope	E_category
Araceae				
Philodendron consanguineum Schott	0.3	3.6	1.17	2HE
Philodendron lacerum (Jacq.) Schott	1.41	5.4	0	2HE
Begoniaceae				
Begonia banaoensis J. Sierra	0	0.9	0	CE
Bromeliaceae				
Catopsis berteroniana (Schult. & Schult. f.) Mez	0.1	0	0.58	H
Catopsis floribunda L. B. Sm	2.02	5.4	23.4	H
Guzmania lingulata (L.) Mez var. lingulata	1.11	22.52	1.17	CE
Guzmania monostachia (L.) Rusby *ex* Mez var. *monostachia*	36.8	7.21	4.09	CE
Tillandsia clavispica Mez	5.15	5.4	32.75	H
Tillandsia festucoides Brongn.	0.3	0	0	H
Tillandsia pruinosa Sw.	1.71	0	0.58	H
Tillandsia utriculata L. subsp. *utriculata* f. *utriculata*	0	0.9	0	H
Tillandsia variabilis Schlecht.	14.1	11.71	13.45	CE
Cactaceae				
Rhipsalis baccifera (J. S. Muell.) Stearn	0.1	0	0	H
Selenicereus grandiflorus (L.) Britton & Rose	0.3	0	0	2HE
Marcgraviaceae				
Marcgravia trinitatis C. Presl	0	6.31	0	C
Moraceae				
Ficus sp.	0.1	0	0	1HE
Orchidaceae				
Anathallis sertularioides (Sw.) Pridgeon & M. W. Chase	2.62	0	0.58	H
Brassia caudata (L.) Lindl.	1.11	3.6	1.17	H
Epidendrum difforme Jacq.	0	0	0.58	CE
Epidendrum nocturnum Jacq.	0.3	0	0	H
Eurystyles ananassocomus (Rchb. f.) Schltr.	0	0.9	0	H
Polystachya concreta (Jacq.) Garay & H. R. Sweet	2.02	3.6	0.58	H
Prosthechea cochleata (L.) Dressler	0.81	0	0.58	CE
Specklinia corniculata (Sw.) Steud.	2.02	0	1.17	H
Specklinia tribuloides (Sw.) Pridgeon & M. W. Chase	13.6	0	0	H
Trichocentrum undulatum (Sw.) Ackerman & M. W. Chase	0.81	1.8	0	CE
Vanilla dilloniana Correll	2.32	3.6	2.34	C
Piperaceae				
Peperomia glabella (Sw.) A. Dietr. var. *glabella*	0.71	0	1.17	CE

Peperomia obtusifolia (L.) A. Dietr.	2.72	3.6	1.17	CE
Peperomia rotundifolia (L.) Kunth	3.83	0.9	0.58	CE
Polypodiaceae				
Campyloneurum phyllitidis (L.) C. Presl	0	0.01	0.58	CE
Microgramma heterophylla (L.) Wherry	0.1	2.7	0.58	C
Microgramma piloselloides (L.) Copel	2.72	13.51	11.7	C
Serpocaulon triseriale (Sw.) A. R. Sm.	0.5	0	0	H
Psilotaceae				
Psilotum nudum (L.) Beauv.	0	0.9	0	H
Rubiaceae				
Hillia tetrandra Sw.	0.1	0	0	H
Urticaceae				
Pilea pubescens Liebm.	0	0.9	0	CE
Total of individual	**991**	**111**	**171**	**1273**

In the shrub wood vegetation at top of Mogote La Sabina, 991 individuals of 29 species were recorded. The most abundant species were *Guzmania monostachia* (Bromeliaceae) (Photo 2), *Tillandsia variabilis* (Bromeliaceae) and *Splecklinia tribuloides* (Orchidaceae). The rest of the epiphytes species were in a relative abundance less than 10%.

Photo 2: *Guzmania monostachia* var. *monostachia* (Bromeliaceae), the dominant species of the epiphytic synusia in the shrub wood vegetation at top of Mogote La Sabina, Ecological Reserve Alturas de Banao, Guamuhaya range, Central Cuba

The cacti epiphytic species *Rhipsalis baccifera* (Photo 3a) and *Selenicereus grandiflorus* (Photo 3b), and *Tillandsia festucoides* (Bromeliaceae), *Ficus sp.* (Moraceae), the orchids *Epidendrum nocturnum* (Photo 3c) and *Specklinia tribuloides* (Photo 3d) and *Hillia tetrandra* were only found in the epiphytic synusia at the top of the Mogote.


3a


3b


3c


3d

Photo 3: Some of the epiphytic species that compose the epiphytic synusia at top of Mogote La Sabina, Ecological Reserve Lomas de Banao, Central Cuba. 3a. *Rhipsalis baccifera* (Cactaceae); 3b. *Selenicereus grandiflorus* (Cactaceae); 3c. *Epidendrum nocturnum* (Orchidaceae); 3d. *Specklinia tribuloides* (Orchidaceae)

In the northern slope of Mogote La Sabina, in the evergreen forest, 111 individuals of 22 species were recorded. *Guzmania lingulata* (Bromeliaceae) was the dominant species (Photo 4), followed by the fern *Microgramma piloselloides* (Polypodiaceae) and *Tillandsia variabilis* (Bromeliaceae).

Photo 4: *Guzmania lingulata* (Bromeliaceae), the dominant species of the epiphytic synusia in the evergreen forest at the northern slope of Mogote La Sabina, Ecological Reserve Alturas de Banao, Guamuhaya range, Central Cuba

5a


5b


Photo 5: Some of the epiphytic species that compose the epiphytic synusia at evergreen forest of the northern slope of Mogote La Sabina, Ecological Reserve Altras de Banao, Central Cuba.5a. *Begonia banaoensis* (Begoniaceae); 5b. *Marcgravia trinitatis* (Marcgraviaceae)

A total of 171 individuals of 21 species were recorded in the southern slope of Mogote La Sabina. The family plant Bromeliaceae was the most abundant in the evergreen forest of the southern slope of Mogote La Sabina. *Tillandsia clavispica* (Photo 3), was the dominant species, followed by *Catopsis floribunda* and *Tillandsia variabilis*.

Photo 3: *Tillandsia clavispica* (Bromeliaceae), the dominant species of the epiphytic synusia in the evergreen forest at the southern slope of Mogote La Sabina, Ecological Reserve Alturas de Banao, Guamuhaya range, Central Cuba

In the southern slope, the epiphytic synusia was composed by species already present in the other vegetation that conform the complex, except for the presence of *Epidendrum nocturnum* (Orchidaceae).

MACROHABITAT CHARACTERIZATION: COMPOSITION AND VEGETATION STRUCTURE

The floristic composition of vegetation where the epiphytic synusia inhabit at Mogote La Sabina is composed by is shown in table 2.

Table 2: Floristic composition of vegetation at top, northern (N_Slope) and southern slope (S_Slope) of Mogote La Sabina, Ecological Reserve Alturas de Banao, Central Cuba. Relative Abundance (RA: %) and phorophyte percentage per species (Ph: %)

Taxa per plant family	Top		N_slope		S_slope	
	RA	Ph	RA	Ph	RA	Ph
Anacardiaceae						
Euleria tetramera Urb.	0	0	0	0	0.9	0
Annonaceae						
Oxandra lanceolata (Sw.) Baill.	0	0	0.7	0	0	0
Apocynaceae						
Plumeria obtusa L.	1.5	0.75	0	0	0	0

Rauvolfia nitida Jacq.	0	0	2	0.66	0	0
Tabernaemontana alba Mill.	0	0	2.7	0	0	0
Aquifoliaceae						
Ilex dioica (Vahl) Griseb.	0	0	0	0	0.9	0
Araceae						
Philodendron lacerum (Jacq.) Schott.	0	0	0.7	0.66	0	0
Arecaceae						
Roystonea regia (Kunth) O. F. Cook	1.3	0.66	0	0		
Bignoniaceae						
Tabebuia calcicola Britton	0.4	0.75	1.3	1.32	0.9	0.91
Tecoma stans (L.) Juss. ex Kunth	0	0	0	0	0	0
Boraginaceae						
Cordia gerascanthus L.	0.7	1.51	1.3	1.32	1.8	1.82
Burseraceae						
Canarium zeylanicum (Retz.) Blume	0.4	0	0	0	0	0
Celastraceae						
Schaefferia frutescens Jacq.	1.8	0.75	0	0	0	0
Combretaceae						
Buchenavia tetraphylla (Aubl.) R.A.Howard	0.4	0.75	1.3	0.66	0.9	0
Compositae						
Critonia dalea (L.) DC.						
Leonis trineura (Griseb.) B. Nord.	0	0	0	0	0	0
Convolvulaceae						
Ipomoea carolina L.	0.7	0	0	0	0	0
Dilleniaceae						
Doliocarpus dentatus (Aubl.) Standl.	0	0	0.7	0	0	0
Dioscoreaceae						
Dioscorea tamoidea Griseb.	0.4	0	0	0	0	0
Ebenaceae						
Diospyros caribaea (A.DC.) Standl.	0.4	0.75	0	0	0.9	0.91
Elaeocarpaceae						
Sloanea amygdalina Griseb.	0	0	0.7	0	0	0
Erythroxylaceae						
Erythroxylum areolatum L.	0	0	2	0	0	0
Erythroxylum havanense Jacq.	3.3	3.03	0.7	0.66	0.9	0
Euphorbiaceae						
Adelia ricinella L.	3.3	5.3	2	1.32	2.7	2.73

Bernardia corensis (Jacq.) Müll.Arg.	1.1	0	0	0	0	0
Croton lucidus L.	4.4	0.75	0	0	0	0
Croton rectangularis	0.4	0	0	0	0	0
Drypetes sp.	0	0	0.7	1.32	0.9	0.91
Gymnanthes albicans (Griseb.) Urb.	0.7	0.75	0	0	6.4	1.82
Gymnanthes pallens (Griseb.) Müll.Arg.	0	0	2.7	0.66	0	0
Jatropha integerrima Jacq.	0	0	0.7	0.66	0	0
Platygyna hexandra (Jacq.) Müll.Arg.	1.5	0.75	0	0	0	0
Savia bahamensis Britton	8.4	12.2	0	0	5.5	0
Savia perlucens Britton	0	0	3.3	0.66	0	0
Lauraceae						
Cinnamomum montanum (Sw.) J. Presl.	0	0	2.7	0	0	0
Licaria triandra (Sw.) Koesterm.	0	0	0	0	0.9	0.91
Nectandra coriacea (Sw.) Griseb.	0.4	0	0	0	3.6	1.82
Ocotea cuneata (Nees) J.F. Macbr.	0	0	0.7	0	0	0
Ocotea floribunda (Sw.) Mez	0	0	0.7	0.66	0	0
Ocotea leucoxylon (Sw.) Laness.	0	0	3.3	1.32	0	0
Ocotea nemodaphne Mez	0	0	1.3	1.32	0	0
Leguminosae						
Cojoba arborea (L.) Britton & Rose	2.2	3.02	8	3.31	3.6	1.82
Lonchocarpus heptaphyllus (Poir.) DC.	0	0	5.3	0.66	0.9	0.91
Lonchocarpus sericeus (Poir.) DC.	0.4	0.75	0.7	0.66	1.8	1.82
Senna ligustrina (L.) H.S.Irwin & Barneby	0.4	0	0	0	0	0
Lythraceae						
Ginoria ginorioides (Griseb.) Britton	0.4	0.75	0	0	0	0
Malpighiaceae						
Bunchosia emarginata Regel	6.5	6.06	0.7	0	8.2	2.73
Stigmaphyllon sagraeanum A. Juss.	1.8	0	0	0	0.9	0
Malvaceae						
Ceiba pentandra (L.) Gaertn.						
Melastomataceae						
Tetrazygia bicolor (Mill.) Cogn.	0	0	0.7	0	0	0
Meliaceae						
Guarea guara (Jacq.) P. Wilson	0	0	2.7	1.32	1.8	0.91
Guarea guidonia (L.) Sleumer	0	0	4.6	1.32	0	0
Trichilia havanensis Jacq.	3.3	3.03	0	0	0	0

Trichilia hirta L.	0	0	1.3	0.66	0	0
Moraceae						
Ficus citrifolia Mill.	0	0	1.3	0	0	0
Pseudolmedia spuria (Sw.) Griseb.	0	0	0	0	0	0
Myrtaceae						
Calyptranthes rotundata Griseb.	11	19.7	0	0	0	0
Eugenia asperifolia O. Berg	1.8	1.09	0	0	0	0
Eugenia heterophylla A. Rich.	0	0	0.7	0	0	0
Nyctaginaceae						
Pisonia aculeata L.	1.8	1.51	2	0	1.8	0.91
Oleaceae						
Chionanthus ligustrinus (Sw.) Pers.	0.4	0	0.7	0.66	0	0
Picramniaceae						
Picramnia pentandra Sw.	1.5	6.06	2	0.66	3.6	0.91
Picramnia reticulata Griseb.	4.4	1.09	0.7	0	1.8	0
Poaceae						
Arthrostylidium multispicatum Pilg.	0	0	0.7	0	0	0
Polygalaceae						
Badiera oblongata Britton	0.7	0	0	0	0	0
Primulaceae						
Myrsine coriacea (Sw.) R.Br. ex Roem. & Schult.	0.4	0.75	0	0	0	0
Rhamnaceae						
Karwinskia rocana Urb.	4	7.57	0	0	0	0
Rubiaceae						
Antirhea sp.	0	0	0	0	1.8	0
Chiococca alba (L.) Hitchc	0.7	0	0	0	0.9	0
Chione venosa var. *cubensis* (A.Rich.) David W.Taylor	0	0	6.6	2.65	0	0
Erithalis fruticosa L.	0.4	0	0	0	0	0
Exostema valenzuelae A. Rich.	0.4	0	0	0	0	0
Faramea occidentalis (L.) A. Rich.	0	0	9	0.66	8.2	1.82
Guettarda sp.	0	0	0.7	0	0	0
Lasianthus lanceolatus (Griseb.) Urb.	0	0	0.7	0	0	0
Psychotria nervosa Sw.	6.2	0	2	0	5.5	0
Psychotria revoluta DC.	0.7	0	0	0	0.9	0
Psychotria sp.	0	0	2.7	0.66	0	0
Rondeletia odorata Jacq.	1.8	0	0.7	0	0.9	0

Rutaceae						
Pilocarpus racemosus Vahl	5.1	7.57	0	0	3.6	0.91
Zanthoxylum caribaeum Lam.	0	0	0	0	0.9	0
Zanthoxylum martinicense (Lam.) DC.	0.4	0.75	0	0	0	0
Salicaceae						
Casearia aculeata Jacq.	0.4	0.75	0	0	0	0
Casearia guianensis (Aubl.) Urb.	0.4	0.75	0	0	0	0
Casearia sp.	0	0	0.7	0	0	0
Casearia spinescens (Sw.) Griseb.	1.1	1.51	0	0	0	0
Casearia sylvestris Sw.	1.1	1.51	3.3	0	3.6	0
Samyda macrantha P. Wilson	0.4	0.75	0.7	0.66	0.9	0.91
Zuelania guidonia (Sw.) Britton & Millsp.	0.4	0.75	2	1.32	6.4	6.36
Sapindaceae						
Allophylus cominia (L.) Sw.	0	0	5.3	1.99	5.5	0.91
Cupania americana L.	0	0	0.7	0	0	0
Matayba domingensis (DC.) Radlk.	0	0	0	0	0.9	0
Serjania diversifolia (Jacq.) Redlk.	0.7	0.75	0	0	0	0
Smilacaceae						
Smilax havanensis Jacq.	1.1	0	0	0	0	0
Solanaceae						
Brunfelsia macroloba Urb.	0.4	0	0	0	0.9	0
Cestrum laurifolium L'Hér.	0	0	0	0	0	0
Solandra longiflora Tussac	0.4	0.75	0	0	0	0
Verbenaceae						
Citharexylum caudatum L.	0.4	0.75	1.3	0.66	0.9	0
Citharexylum spinossum L.	2.2	1.51	0	0	0	0
Vitaceae						
Cissus sp.	0.4	0.75	0	0	0	0
Cissus verticillata (L.) Nicolson & C.E.Jarvis	0.7	0	0	0	0	0
Vitis tiliaefolia Willd.	0	0	0.7	0	0	0
Total individual	**275**	**132**	**151**	**38**	**110**	**39**

The floristic inventory of the shrub wood, on top of Mogote La Sabina, was composed by 58 species, 50 genera and 33 families being families Euphorbiaceae, Rubiaceae and Flacourtiaceae with major species richness. In terms of abundance Euphorbiaceae also ranks first, followed by the families Myrtaceae, Rubiaceae and Malpighiaceae. The phorophytes were 132 and predominated in the same diameter class and 79% showed the rough bark. They were distributed in 26 families. Euphorbiaceae and Myrtaceae provide the main host trees to the epiphytic synusia: Calyptranthes rotundata (19.7%; Myrtaceae), Savia bahamensis (12.12%, Euphorbiaceae), Karwinskia Rocana (7.6%; Rhamnaceae), Pilocarpus racemosus (7.6%; Rutaceae), Picramnia reticulata (6.1%; Simaroubaceae) and Bunchosia emarginata (6.1% Malpighiaceae). The shrub layer was predominant, with an average of 3 m height and an average of 53.4% in the understory density. The canopy cover was high, 71.4%, and limestone rocks cover 45% of the ground. A total of 275 trees were sampled. The predominant DBH classes were 1 and 2, typical of shrubs, and most of them with rough bark (57%).

In the Evergreen Forest of the northern slope, the florula is composed by 51 species, 42 genera and 28 families, the most represented: Rubiaceae (7 spp.), Euphorbiaceae, Lauraceae (both with 5 spp.) and Flacourtiaceae (4 spp.). In abundance, families Rubiaceae, Euphorbiaceae and Mimosaceae are the most important. Only 38 trees were phorophytes all of them with DBH over the 16cm, and 76.3% presented the rough bark. Of the 19 plant families who support the epiphyte synusia the more

abundant were Euphorbiaceae, Meliaceae, Mimosaceae and Rubiaceae and at species level *Cojoba arborea* (13.2%, Mimosaceae) and *Chione cubensis* (10.5%, Rubiaceae) are the most selected host trees, the rest do it in less than 6%. The arboreal layer was dominant with an average of 5-6 m height and 76.6% coverage, the understory density average was 44.8% and only the 13.3% was covered by rocks. The total number of sampled trees was 151, most of them among the DBH Class 4, with smooth bark (50%).

The floristic composition of the Evergreen Forest of southern slope consists of 38 species, 35 genera and 21 families, of which Rubiaceae (6 spp.) and Euphorbiaceae (4 spp.) have the highest species richness and abundance of individuals. In the plot, 15 families were host for the epiphytic community, constituting the most important Flacourtiaceae providing more than 7% of total phorophytes (39). They predominate in the largest diameter classes (DBH 4 and 5) and the highest percentage presented the rough bark (92.3%). The most important host species were: *Zuelania guidonia* (17.9%, Flacourtiaceae) and *Adelia ricinella* (7.7%, Euphorbiaceae), the rest contributed less than 6%. The dominant layer is arboreal, with a mean canopy height of 6-8 m with coverage of 80%, the average density of understory 47.2% and the rockiness was poorly represented at 6.7%. In the area a total of 110 trees were sampled, distributed mainly in the first two diameter classes, the rough bark was the predominant (73.6%).

The significance of the statistic differences resulting from the non parametric lineal regression analysis of tree diameter classes (Table 3) shows that number of phorophyte trees increase linearly when diameter of tree trunk increase too.

Table 3: Number of trees (+: phorophytes, no phorophytes) per DBH (DBH 1,5<Ø<4.0 cm; DBH 2: 4.1<Ø<6.0 cm; DBH 3: 6.1<Ø<10.0 cm; DBH 4: 10.1<Ø<16.0 cm and DBH 5: Ø>16.1 cm), sampled at top, northern (N_Slope) and southern slope (S_Slope) of Mogote La Sabina, Ecological reserve Alturas de Banao, Central Cuba. Non Parametric Lineal Regression analyze of tres per diametric clases (b: estadístico de posición; g.l.: liberty degrees; X^2: estatistic chi cuadrado).

Mogote la Sabina		DBH 1	DBH 2	DBH 3	DBH 4	DBH 5
Top	+	26	31	17	11	12
	-	16	12	3	12	4
N_Slope	+	9	7	8	7	10
	-	27	13	6	6	9

S_Slope	+	6	3	6	8	10
	-	9	13	5	4	1
	b= 0.050 ± 0.01; g.l.= 1; X^2= 18.94***					

According to the type of bark in the three vegetation types the rough bark prevailed among phorophytes (Table 4).

Table 4: Percentage of phorophytes according to the bark type at shrub Wood of the top, and the evergreen forests of the northern (N_Slope) and southern slopes (S_Slope) of Mogote La Sabina, Ecological Reserve Alturas de Banao, Guamuhaya, Central Cuba.

Mogote La Sabina	Smooth bark	Rough bark
Top	21	79
N_Slope	23.68	76.3
S_Slope	27.4	73.6

EPIPHYTIC SPECIES RICHNESS RELATIONSHIP WITH THE STRUCTURE AND FLORISTIC COMPOSITION OF THE VEGETATION

The greatest vascular epiphytic species richness was found in the tree diameter class 5 (up 16cm), where 28 species were recorded (Fig. 2).

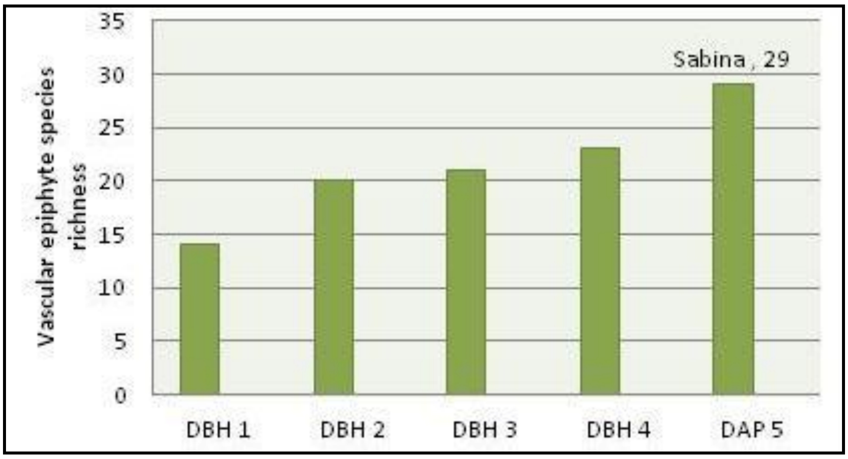

Figure 2: Vascular epiphytic species richness per tree diametric classes (DBH 1: 2.6<Ø<4.0; DBH 2: 4.1<Ø<6.0; DBH 3: 6.1<Ø<10.0; DBH 4: 10.1<Ø<16.0 and DBH 5: Ø>16.1).

The nonparametric Spearman rank correlation analysis (Table 5), revealed a significant and positive correlation between the vascular epiphytic species richness and the largest tree diameter classes (DBH 3, 4, 5), being stronger with the holo-epiphytic species. Also was highly significant the correlation with epiphyte species richness and the rough bark. This pattern evidence that the probability to survive a seed of a vascular epiphyte is higher in those trees with bigger diameters and rough barks (Wallace 1981).

Table 5: Non parametric Spearman Rank correlation values between the macrohabitat variables evaluated (tree trunk diameter at breast hight classes: DBH 1: 2.6<Ø<4.0; DBH 2: 4.1<Ø<6.0; DBH 3: 6.1<Ø<10.0; DBH 4: 10.1<Ø<16.0 and DBH 5: Ø>16.1; Type of bark (smooth or rough); canopy cover; undergrowth density; rockiness) and the epiphytic species richness (S), recognizing the holo-epiphytic species from the rest of the epiphyte categories

Variables	Holoepiphyte species richness	Other epiphyte categories species richness	Total epiphitic species richness
DBH 1	0.030 n. s.	-0.319 n. s.	-0.212 n. s.
DBH 2	0.551 n. s.	0.087 n. s.	0.212 n. s.
DBH 3	0.986***	0.638 n. s.	0.820*
DBH 4	0.928**	0.406 n. s.	0.637 n. s.
DBH 5	0.696 n. s.	0.754 n. s.	0.820*
Smooth bark	-0.495 n. s.	-0.389 n. s.	-0.456
Rough bark	0.889 **.	0.813*	0.845**
Canopy cover (%)	-0.132 n. s.	-0.368 n. s.	-0.339 n. s.
Undergrowth density (%)	0.058 n. s.	-0.058 n. s.	0.030 n. s.
Rockiness. (%)	-0.290 n. s.	0.058 n. s.	-0.152 n. s.

Although the non parametric correlation analysis indicates that the rest of the structural parameters do not significantly influence epiphytic species richness, if we analyze the graph of Figure 6, we can establish some relationship between the percentages of epiphytic individuals growing in trees or ground and the macrohabitat variables: canopy cover, undergrowth density and rockiness.

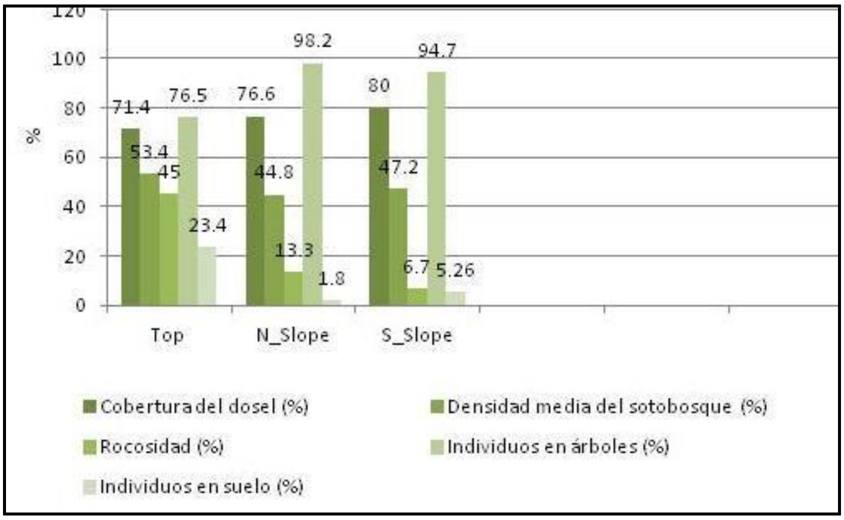

Figure 3: The structural macrohabitat variables values (canopy cover; undergrowth density and rockiness) and percentages of epiphytic individuals (growing on trees and on the ground), found in the shrub wood on top, and evergreen forests at northern and southern slopes of Mogote La Sabina, Ecological Reserve Lomas de Banao, Sancti Spiritus, Central Cuba.

At the top of Mogote La Sabina, the structural variables show a combination that allow us to identify the plot as an open area (lower values of canopy cover and undergrowth density), where epiphytic individuals can receive the necessary lighting without using host trees. No wonder, therefore, that top of mogote exhibit the highest percentage of epiphytic individuals growing on the ground, but also the greatest richness and abundance of vascular epiphytic species.

According to the species composition, the greatest vascular epiphytic species richness in the top of La Sabina was found in trees of the most abundant plant families: Euphorbiaceae and Myrtaceae, where the 60% of the vascular epiphytic species were recorded, indicating that the specificity epiphyte species-phorophyte is low and that vascular epiphytic species are more likely to settle in most abundant host tree species. Nevertheless, in the side slopes the greatest epiphytic species richness was not found on those more abundant tree species (Euphorbiaceae, Rubiaceae, Mimosaceae, Lauraceae and Meliaceae) where less than 25% of the epiphytic species richness was found, but in those trees with bigger diameter class, indicating also the lower specificity in the epiphytic species-host tree relationship and that the diameter of the tree trunk is an important structural variable to the epiphytic synusia.

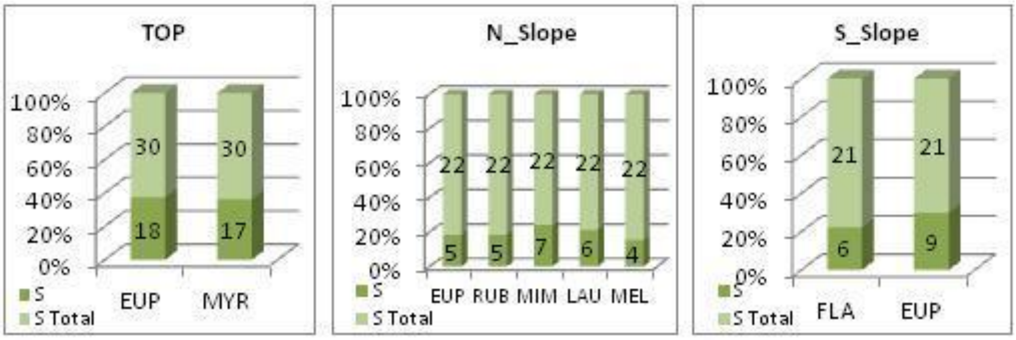

Figure 6: Vascular epiphytic species richness recorded per most abundant plant families that represented more than the 10% of host trees in Mogote La Sabina (top, northern and southern slopes), Ecological Reserve Lomas de Banao, Sancti Spiritus, Central Cuba (EUP: Euphorbiaceae; MYR: Myrtaceae; RUB: Rubiaceae; MIM: Mimosaceae; LAU: Lauraceae: MEL: Meliaceae; FLA: Flacourtiaceae).

MICROHABITAT CHARACTERIZATION: VERTICAL DISTRIBUTION PATTERN, SURROUNDING LIGHTING AND TYPE OF SUBSTRATE

In the plots of "Sabina" the greatest vascular epiphyte species richness (Fig. 7.) is concentrated mostly in Zone 1 and 2 of the phorophyte (lower and upper half of the trunk).

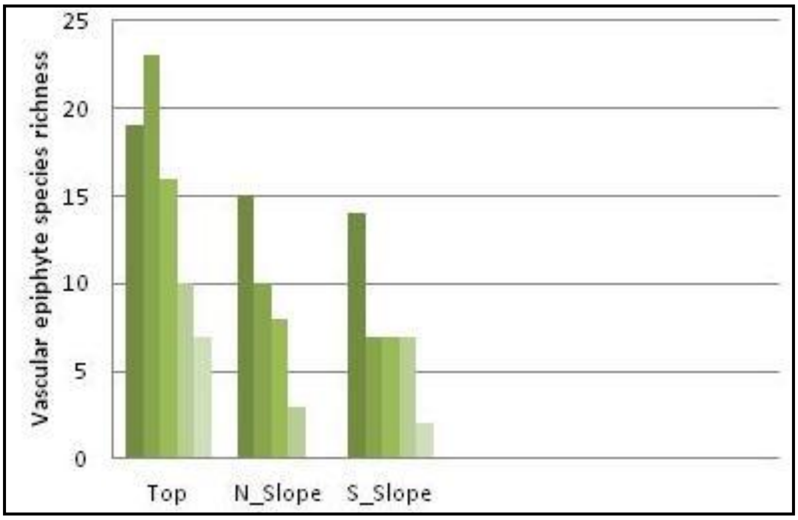

Figure 7. Vascular epiphyte species richness per zones of the phorophyte (Zone 1: inferior half of the trunk; Zone 2: upper half of the trunk; Zone 3: primary branches; Zone 4: secondary branches; Zone 5: tertiary and upper order branches) in Mogote "La Sabina", Ecological Reserve Lomas de Banao, Sancti Spiritus, Central Cuba

In these zones anchored mainly small species of ferns like *Microgramma pilloseloides* (Photo 4a), large bromeliads like *Tillandsia variabilis* (Photo 4b), small orchids like the endemic *Specklinia grisebachiana* (Photo 4c), and casual epiphytes like *Peperomia magnoliifolia*. These zones correspond to the oldest part of phorophyte, a condition that significantly affects the richness of epiphytes (Catling & Lefkovitch 1989; Bøgh 1993).


a


b

c d

Photo 4. *Microgramma pilloseloides* (A; Polypodiaceae), *Tillandsia variabilis* (B; Bromeliaceae), *Specklinia grisebachiana* (C; Orchidaceae) and *Peperomia magnoliifolia* (D; Piperaceae), vascular epiphytes commonly found in the tree trunks of phorophytes in Mogote "La Sabina", Ecological Reserve Lomas de Banao, Sancti Spiritus, Central Cuba

The upper regions of phorophyte is reached by meso-xerophytic bromeliads as *Tillandsia clavispica* and *T. utriculata* (Photo5a) and *Catopsis berteroniana* (Photo 5b), protruding from the other forms of life, such as primary hemi-epiphytes like *Ficus spp*. and secondary hemi-epiphytes like *Philodendron lacerum* (Photo 5c), which can reach these areas depending on the requirements of light, as do some semi-epiphytic climbers like *Vanilla dilloniana*. Casual Epiphytes reaching these areas are mainly bromeliads and peperomias (Photo 5d).

a b c d

Figura 5. *Tillandsia utriculata* (A; Bromeliaceae), *Catopsis berteroniana* (B; Bromeliaceae), *Philodendron lacerum* (C; Araceae) and *Peperomia quadrifolia* (Piperaceae), common vascular epiphytes species in the upper zones of the host tree in Mogote “La Sabina”, Ecological Reserve Lomas de Banao, Sancti Spiritus, Central Cuba

According to the surrounding lighting over 90% of the species are growing under filtered light conditions (Fig. 8).

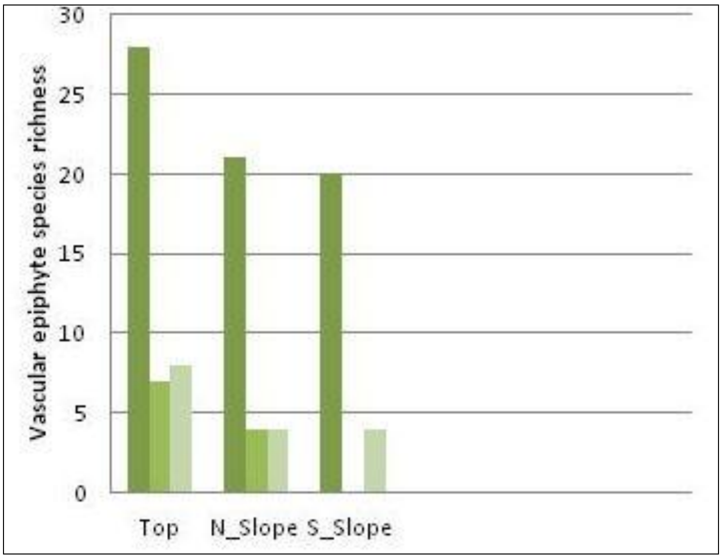

Figura 8: Vascular epiphyte species richness under different light intensity (FL: filtered light; S: Shadow; DL: Direct Light), in Mogote "La Sabina", Ecological Reserve Lomas de Banao, Sancti Spiritus, Central Cuba

The species found in shadow also grow under filtered light conditions like *Tillandsia pruinosa* (Photo 6a).

Photo 6. *Tillandsia pruinosa* (Bromeliaceae), an epipjhyte that grows in shadow and under filtered light conditions in Mogote "La Sabina", Ecological Reserve Lomas de Banao, Sancti Spiritus, Central Cuba

Receiving direct sunlight we only found few species (eg *Tillandsia clavispica*, *Catopsis berteroniana, Ficus spp.*). The unique species that showed preference for this condition was *Catopsis berteroniana* (Bromeliaceae), behavior that may be related to the characteristics of this plant, an insectivorous xerophytic bromeliad, covered with numerous white scales that reflect ultraviolet light to attract insects sensitive to this radiation (Benzing 1990).

According to the substrate (Fig. 9), the tree bark was the one used by the 90% of epiphytic species being preferred the rough bark.

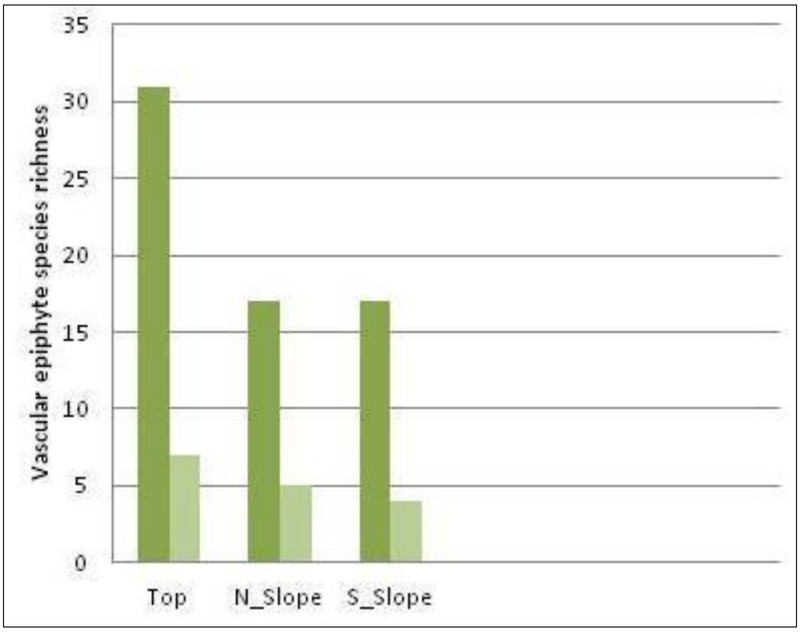

Figure 9. Vascular epiphyte species richness per colonized substrate (Bark and Humus), in Mogote "La Sabina", Ecological Reserve Lomas de Banao, Sancti Spiritus, Central Cuba

The rough bark favors and facilitates the establishment of epiphyte seeds mostly scattered by the wind, since they retain more moisture and therefore guarantee successful germination thereof. This result agrees with Dressler (1990) and Migenis & Ackerman (1993). Humus tanks were the second substrate in importance, primarily used by casual epiphytes growing on the ground (eg *Guzmania spp*), and for those species that grow on trees associated with accumulations of organic matter (eg *Peperomia obtusifolia* and *Pleopeltis triseriale*), also accidental epiphytes (eg *Critonia dalea* and *Pilea pubescens*) and primary hemi-epiphytes (eg Ficus sp.). No evidence of post-mortem colonization of epiphytes was recorded on evaluated dead trunks. The species found in this substrate had already been colonized it alive.

CONCLUSION

Based in the previous results, we can concluded that in Mogote Vegetation Complex at Mogote "La Sabina", the higher vascular epiphyte species richness occurs in the lower areas of phorophyte (host tree trunk), with trunk diameter up 16 cm and rough bark and under filtered light. Casual epiphytes are growing on the ground on those areas with low canopy cover and well developed rockiness with organic matter where the species can grow and complete the life cycle.

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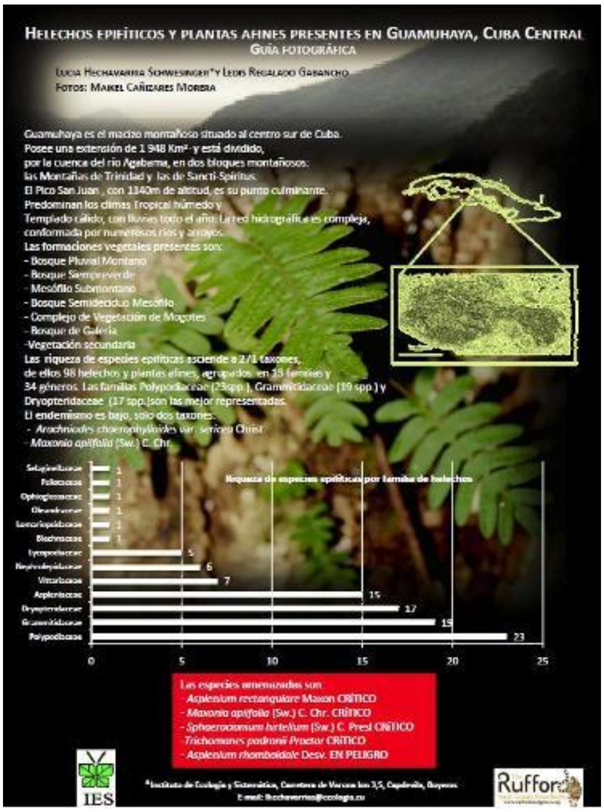
ANNEX 3

ANNEX 4



ANNEX 5


CURUJEYES (BROMELIACEAE) PRESENTES EN GUAMUHAYA, CUBA CENTRAL
GUÍA FOTOGRÁFICA
LUCIA HECHAVARRIA SCHWESINGER*
FOTOS: MAIKEL CAÑIZARES MORERA
Guamuhaya es el macizo montañoso situado al centro sur de Cuba. Posee una extensión de 1 948 Km² y está dividido, por la cuenca del río Agabama, en dos bloques montañosos:
las Montañas de Trinidad y las de Sancti Spiritus.
El Pico San Juan, con 1140m de altitud, es su punto culminante.
Predominan los climas Tropical húmedo y Templado cálido, con lluvias todo el año.
La red hidrográfica es compleja, conformada por numerosos ríos y arroyos.
Las formaciones vegetales presentes son:
- Bosque Pluvial Montano
- Bosque Siempreverde
- Mesófilo Submontano
- Bosque Semideciduo Mesófilo
- Complejo de Vegetación de Mogotes
- Bosque de Galería
-Vegetación secundaria
Las riqueza de especies epífiticas asciende a 271 taxones, de ellos 33 especies de Bromeliaceae, agrupados en 7 géneros. Tillandsia es el género mejor representado con 21 especies.
Riqueza de especies epífiticas por géneros de Bromeliaceae
25
20
15
10
5
0
Aechmea
Catopsis
Guzmania
Hohenbergia
Tillandsia
Vriesea
Las especies amenazadas son:
Tillandsia argentea Griseb. (A)
Tillandsia butzii Mez (A)
Tillandsia deppeana Steud. (A)
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Rufford