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Richness and structure of a semideciduous microphyll forest of Eastern Cuba at different cover levels of Leucaena leucocephala

Riqueza y estructura de un bosque semideciduo micrófilo de Cuba Oriental a diferentes niveles de cobertura de Leucaena leucocephala

Riqueza e estrutura de uma floresta semidecídua micrófila do leste de Cuba em diferentes níveis de cobertura de Leucaena leucocephala

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ABSTRACT

The invasion of exotic species of natural spaces constitutes a global conservation problem. In the Siboney- Juticí Ecological Reserve, *Leucaena leucocephala* is considered one of the main threats to the conservation of the semideciduous microphyll forest. The objective of this study is to characterize the richness and structure of the semideciduous microphyll forest

in areas with different levels of *Leucaena leucocephala* coverage in that reserve. For the study, 15 plots of 400 m ^{2} were established at three levels of coverage of the invasive species: ABSM-NI (undisturbed forests), ABSM-PI (40-60 % coverage of *Leucaena leucocephala)* and ABSM-TI (70 % cover of *Leucaena leucocephala)*. The number of individuals per species and their presence in each of the stratus were estimated, in addition, the height of the woody species was considered. For each of the levels studied, the specific richness, the relative abundance of the species and the floristic composition by stratus were determined; as well as the floristic similarities between each of the levels. In ABSM-NI, 55 species were recorded, in ABSM-PI 51 and in ABSM-TI 43. At the three levels of cover, the strata (tree, shrub, herbaceous) and lianas were maintained. In ABSM-TI the epiphytes were not recorded. The greatest biological similarity was between ABSM-PI and ABSM-TI; some of the shared species are ruderal and colonize areas with some type of disturbance. The main transformation was in the composition and abundance of the species as the coverage of the invasive species increased. In ABSM-TI, the specific richness and abundance/cover of secondary vegetation species increased, to the detriment of other typical forest species. In the sites with the greatest coverage of the invasive species, a decrease in the specific composition and height of the tree stratus occurs. At this site, an increase in the specific composition of the shrub and herbaceous strata was also observed. Epiphytes were only recorded in ABSM-NI and ABSM-PI.

Keywords: protected area, invasive alien species, species invasion, coastal zone.

RESUMEN

La invasión de especies exóticas de espacios naturales constituye un problema de conservación a nivel global. En la Reserva Ecológica Siboney-Juticí, *Leucaena leucocephala* es considerada como una de sus principales amenazas para la conservación del bosque semideciduo micrófilo. El objetivo de este estudio es caracterizar la riqueza y estructura del bosque semideciduo micrófilo en áreas con diferentes niveles de cobertura de *Leucaena leucocephala* en dicha reserva. Para el estudio se establecieron 15 parcelas de 400 m^2 en tres niveles de cobertura de la especie invasora: ABSM-NI (bosques sin perturbación), ABSM-PI

(40-60 % de cobertura de *Leucaena leucocephala*) y ABSM-TI (70 % de cobertura de *Leucaena leucocephala*). Se estimó el número de individuos por especie y su presencia en cada uno de los estratos, además se consideró la altura de las especies leñosas. Por cada uno de los niveles estudiados se determinó la riqueza específica, la abundancia relativa de las especies y la composición florística por estratos; así como las similitudes florísticas entre cada uno de los niveles. En ABSM-NI se registraron 55 especies, en ABSM-PI 51 y en ABSM-TI 43. En los tres niveles de cobertura se mantuvieron los estratos (arbóreo, arbustivo, herbáceo) y las lianas. En ABSM-TI no se registraron epífitas. La mayor similitud biológica fue entre ABSM-PI y ABSM-TI; muchas de las especies compartidas son ruderales y colonizan áreas con algún tipo de perturbación. La principal transformación estuvo en la composición y abundancia de las especies en la medida que aumenta la cobertura de la especie invasora. En ABSM-TI incrementó la riqueza específica y la abundancia/cobertura de especies propias de vegetación secundaria, en detrimento de otras especies típicas del bosque. En los sitios de mayor cobertura de la especie invasora ocurre una disminución de la composición específica y altura del estrato arbóreo. En este sitio también se observó un aumento de la composición específica de los estratos arbustivo y herbáceo. Las epífitas solo se registraron en ABSM-NI y ABSM-PI.

Palabras clave*:* área protegida, especies exótica invasoras, invasión de especie, zona costera.

RESUMO

A invasão de espécies exóticas em espaços naturais constitui um problema de conservação global. Na Reserva Ecológica Siboney-Juticí, Leucaena leucocephala é considerada uma das principais ameaças à conservação da floresta semidecídua microfila. O objetivo deste estudo é caracterizar a riqueza e a estrutura da floresta semidecídua micrófila em áreas com diferentes níveis de cobertura de *Leucaena leucocephala* na referida reserva. Para o estudo foram estabelecidas 15 parcelas de 400 m2 em três níveis de cobertura das espécies invasoras: ABSM-NI (florestas intactas), ABSM-PI (40-60 % de cobertura de *Leucaena leucocephala*) e ABSM-TI (70% de cobertura de *Leucaena leucocephala*). Foi estimado o número de indivíduos por espécie e sua presença em cada um dos estratos, sendo também

considerada a altura das espécies lenhosas. Para cada um dos níveis estudados foram determinadas a riqueza específica, a abundância relativa das espécies e a composição florística por estratos; bem como as semelhanças florísticas entre cada um dos níveis. Na ABSM-NI foram registradas 55 espécies, na ABSM-PI 51 e na ABSM-TI 43. Nos três níveis de cobertura foram mantidos os estratos (arbóreo, arbustivo, herbáceo) e lianas. Nenhuma epífita foi registrada no ABSM-TI. A maior similaridade biológica foi entre ABSM-PI e ABSM-TI; muitas das espécies compartilhadas são ruderais e colonizam áreas com algum tipo de perturbação. A principal transformação ocorreu na composição e abundância das espécies à medida que aumentava a cobertura das espécies invasoras. Na ABSM-TI, a riqueza específica e a abundância/cobertura de espécies de vegetação secundária aumentaram, em detrimento de outras espécies florestais típicas. Nos locais com maior cobertura das espécies invasoras ocorre diminuição da composição específica e da altura do estrato arbóreo. Neste local também foi observado aumento na composição específica dos estratos arbustivos e herbáceos. Epífitas foram registradas apenas no ABSM-NI e ABSM-PI.

Palavras-chave: área protegida, espécies exóticas invasoras, invasão de espécies, zona costeira.

INTRODUCTION

The colonization of natural spaces by exotic species has increased the interest of researchers and environmental managers around the world (Villate *et al.* 2016, Hofman and Rick 2018, Díaz *et al.* 2019). Many of these colonizing species can be considered invasive species and are widely recognized as one of the main threats to biodiversity worldwide and the second reason for the extinction of native species, after habitat loss (Oviedo and Gonzalez-Oliva 2015, Mancina *et al.* 2017). These species cause significant economic losses and serious ecological impacts in ecosystems, as they can cause imbalances among populations of wild species, leading to changes in abundance and trophic structure.

In Cuba, the process of species invasion has been identified as one of the five most serious environmental problems for the country, which are contained in the national objectives and goals for species conservation (National Environmental Strategy 2021). Among the ecological effects caused by the invasion of species are the alteration of the diversity, structure and functioning of the invaded ecosystems, which causes variation in the relationships between species and the replacement of native species (Oviedo and González-Oliva 2015, Salmerón-López *et al.* 2015).

The insular nature of the Cuban archipelago, the fragility of its communities and the high endemism of its flora make its ecosystems particularly susceptible targets for biological invasions. In Cuba, based on the National Inventory of Invasive and Potentially Invasive Plants (Oviedo and González-Oliva 2015), other studies have been carried out on the impacts that these species can cause in protected areas; among them we can cite the works of Rodríguez-Cala and González-Oliva (2015) and Testé *et al.* (2015).

In the Biosphere Reserve Baconao also has studies related to invasive plant species (Figueredo *et al.* 2011, Brooks and Figueredo 2015, Brooks *et al.* 2016, Brooks 2021). The Siboney- Juticí Ecological Reserve constitutes one of the core conservation areas of said Biosphere Reserve; 15 species of invasive exotic plants of those referred to by Oviedo and González-Oliva (2015), among them, the one of greatest concern is *Leucaena leucocephala* (Lam.) De Wit species commonly known as ipil ipil. However, the magnitude of the invasion and its impact on the plant diversity of the invaded areas have not been documented for the reserve. Several authors report that *L. leucocephala* (ipil ipil) is a heliophilous plant with great ecological plasticity, so it can easily develop from open places with a high degree of anthropization to more conserved sites in which monospecific patches are formed (Fuentes and González 2011, Alves 2021 and Vossler and Delucchi 2022)

In studies on the functional dynamics and response of the microphyllous semi-deciduous forest of the Siboney- Juticí Ecological Reserve to different disturbances, the presence of invasive species has been considered one of its main threats (Salmerón-López *et al.* 2015, 2016, Salmerón-López and Geada -López 2018). Due to the abundance and diversity of woody plants in the microphyllous semi-deciduous forest decreases in highly disturbed

sites (Salmerón-López *et al.* 2015); it is postulated that as the level of *L. leucocephala* cover increases, the richness of species decreases, as well as the structural complexity of the strata.

For reasons the above, the objective of this study is to characterize the structure of the microphyllous semi-deciduous forest in areas with different levels of *L. leucocephala* coverage in the Siboney- Juticí Ecological Reserve in terms of species richness, species abundance by strata and canopy height; as well as the species similarities between the different levels of coverage of the invasive species. This allows to document the main changes in the forest, which is the object of conservation of the protected area. In addition, basic information for resource management and the selection of species for the restoration of areas colonized by *L. leucocephala* is provided.

MATERIALS AND METHODS

Area of study

Juticí Ecological Reserve is located east of the city of Santiago de Cuba, between 19°56'26'' - 19°58'13'' N and 75°49'32'' - 75°42'24'' W. It occupies a total area of 1,854 ha; of which 1,050 are terrestrial and 804 ha are marine (Salmerón-López *et al.* 2016). It is located in the eastern region of Cuba, east of the city of Santiago de Cuba, on the coastal terraces south of the Sierra Maestra. This territory is dominated by extensive fields of lapiéz (superficial karst formation) and other karst features such as ravines, sinkholes, small canyons and depressions with red soil.

Sampling or study design

The work was carried out in the conservation area of the Siboney- Juticí Ecological Reserve, in the Juticí Sector. Sampling was carried out between April and May 2019.

To characterize the structure, richness and abundance of plant species in forest areas with different levels of *L. leucocephala* coverage, five plots of 20 x 20 m were established, in each of them, a total of 15. To define the coverage levels, the following criteria were followed:

- Semi-deciduous forest areas microphyll no cover (ABSM-NI): Absence of *L. leucocephala,* established forests, without anthropic disturbance for a period of 25 years.
- Partially covered semi-deciduous forest areas (ABSM-PI): 40-60 % *L. leucocephala* cover in the plot.
- Totally covered semi-deciduous forest areas (ABSM-TI): more than 70 % *L. leucocephala* cover in the plot.

Processing of data collected in the field

To estimate the floristic composition, the number of individuals per species present in the plots was recorded. The species were identified in the field, those that were doubtful were collected for determination in the BSC Herbarium. For the taxonomic update and the categories of presence in Cuba, Greuter and Rankin (2022) were consulted.

For each species, relative abundance was calculated as the proportion that represents the total number of individuals of the species with respect to the total number of individuals of all species present at each level. For the comparison between the different areas of microphyllous semi-deciduous forest sampled, the Proportional Similarity Index was applied (Magurran 2013).

For the strata study, the following ranges were considered: herbaceous stratum up to 0.99 m, shrub stratum from 1 to 3 m, and more than 3 m was considered the tree stratum. The density of individuals by stratum and by species was estimated; in the case of the tree stratum, height and emergent species were also taken into account.

RESULTS

Species richness

In the study, 86 species were inventoried, belonging to 72 genera of 41 families. Of the total species, 82 are native (12 endemic and 70 non-endemic native) and four are introduced, of

which three are invasive *Oeceoclades maculata* (Ldl.) Ldl., *Vachellia macracantha* (Humb. et Bonpl . ex Willd.) Seigler et Ebinger and *L. leucocephala* (Lam.) De Wit. The richest families in terms of number of species were: *Rubiaceae* with nine and *Fabaceae* with five. The genera with the highest number of species are *Tillandsia*, *Erythroxylum* and *Guettarda* with three each. Of the introduced species, *Vachellia macracantha* (Willd.) Seigler & Ebinger was recorded in the three areas of study.

Greater specific richness was found in ABSM-NI with respect to ABSM -PI and ABSM -TI (Table 1). In the forest areas with the presence of *L. leucocephala* the number of endemic species was lower. The richness of families and genera also decreased as the invasion process occurred.

Table 1. - Species richness for the microphyllous semi-deciduous forest areas studied in the Siboney-Juticí Ecological Reserve

Categories		**ABSM-NI**	**ABSM-PI**	**ABSM-TI**
Natives	Non-endemic	44	41	36
	Endemic	10	7	4
Introduced	Non Invasive			1
	Invasive	1	3	2
Species richness		55	51	43
Families		30	30	23
Genres		48	45	39

Relative abundance

In ABSM-NI the five species with the highest relative abundance were *Gynamthes lucida*, *Erythroxylum confusum*, *Eugenia iteophylla*, *Coccoloba diversifolia* and *Croton glabellus subsp. glabellus* (Table 2). All except *Erythroxylum confusum* were present in all three areas studied.

The most abundant species in ABSM-PI and ABSM-TI were *L. leucocephala* and *Croton glabellus subsp. glabellus*. Another group of species also abundant in ABSM-PI were, Colubrina *elliptica*, *Eugenia iteophylla*, *Guapira obtuse* subsp. *obtusata* and *Comocladia dentata*.

In the case of ABSM-TI they were *Bourreria virgate*, *Bourreria succulent* and *Erythroxylum rotundifolium* (Table 2).

Table 2. - Relative abundance of woody species in the studied levels of the microphyllous semi-deciduous forest of the Siboney- Juticí Ecological Reserve, Santiago de Cuba

		Relative abundance			
Species	**Status in Cuba**	**ABSM-NI**	**ABSM -PI**	**ABSM -TI**	**Total Abundance**
Gymnanthes lucida Sw .	Native	18.64	1.22	0.22	3.51
Erythroxylum confusum Britton	Native	15.59			2.38
Eugenia iteophylla Krug & Urb.	Endemic	8.78	4.65	0.15	3.59
Coccoloba diversifolia Jacq.	Native	7.53	1.57	0.51	2.08
Croton glabellus L. subsp. *glabellus*	Native	6.63	9.83	8.23	8.74
Sideroxylon salicifolium (L.) Lam.	Native	5.56	0.47		1.07
Erythroxylum rotundifolium Lunan	Native	3.94	0.81	0.87	1.32
Eugenia monticola (Sw .) DC.	Native	3.76	1.05		1.07
Amyris elemifera L.	Native	3.76	0.06	0.51	0.79
Zanthoxylum pistaciifolium Griseb .	Endemic	2.69	0.58		0.68
Diospyros grisebachii (Hiern .) Standl .	Endemic	2.15			0.33
Zanthoxylum fagara (L.) Sarg.	Native	1.97	0.76	0.58	0.88
Guettarda elliptical Sw.	Native	1.61	0.12	0.07	0.33
Randia aculeata L.	Native	1.61	0.17	0.29	0.44
Erithalis fruticosa L.	Native	1.61			0.25
Oplonia polyece (Stearn) Borhidi	Endemic	1.43	0.87	0.15	0.68
Nectandra coriacea (Sw.) Griseb.	Native	1.25			0.19
Thouinia trifoliate Point.	Native	1.25			0.19
Bursera simaruba (L.) Sarg.	Native	1.08	0.17	0.07	0.27
Varronia bullata subsp . *globosa* (Jacq .) Greuter & R. Rankin	Native	0.90	0.12		0.19
Coccothrinax Fragrans Burret	Native	0.72			0.11
Jacaranda caerulea (L.) Juss.	Native	0.54	0.06		0.11
Bourreria virgata (Sw .) G. Don	Native	0.54	0.17	2.69	1.18

Clusia rosea Jacq.	Native	0.54			0.08
Picrodendron baccatum (L.) Krug & Urb.	Native	0.54			0.08
Thouinia trifoliate Point.	Native	0.54			0.08
Sideroxylon foetidissimum Jacq. subsp. *foetidissimum*	Native	0.54			0.08
Comocladia toothed Jacq.	Native	0.36	2.04		1.01
Buxus glomerata (Griseb .) Müll. Arg.	Native	0.36			0.05
Maytenus buxifolia subsp. *cochlearifolia* (Griseb .) Borhidi & O. Muñíz	Endemic	0.36	0.06	0.07	0.11
Lysiloma latisiliquum (L.) Benth.	Native	0.36		0.07	0.08
Vachellia macracantha (Willd.) Seigler & Ebinger	Introduced	0.36	0.58	0.73	0.60
Exostem caribaeum (Jacq.) Roem. & Schult.	Native	0.36	0.12	0.58	0.33
Guettarda leatherensis Britton	Native	0.36	0.17		0.14
Anastraphia microcephala Griseb .	Endemic	0.18			0.03
Crossopetalum rhacoma Crantz	Native	0.18		0.07	0.05
Erythroxylum Havanan Jacq.	Native	0.18		0.15	0.08
Adelia ricinella L.	Native	0.18			0.03
Caesalpinia cubensis Greenm	Native	0.18		0.44	0.19
Pseudocarpidium avicennioides (A. Rich.) Millsp	Endemic	0.18			0.03
Guapira obtusata (Jacq .) Little subsp . *obtusata*	Native	0.18	3.03		1.45
Stenostomum lucidum (Sw .) CF Gaertn .	Native	0.18			0.03
Exothea paniculata (Juss.) Radlk .	Native	0.18			0.03
Citharexylum tristachyum Turcz .	Native	0.18			0.03
Annona squamosa L.	Introduced			0.07	0.03
Tecoma stans (L.) Kunth	Native			0.22	0.08
Bourreria succulent Jacq.	Native			1.31	0.49
Pilosocereus polygonus (Lam.) Byles & GD Rowley	Native		0.17		0.08
Canella winterana (L.) Gaertn	Native		0.12		0.05
Maytenus buxifolia subsp. *cochlearifolia* (Griseb .) Borhidi & O. Muñíz	Endemic		0.47		0.22

Leucaena leucocephala (Lam.) De Wit	Introduced	60.03	80.92	58.71
Senna atomaria (L.) HS Irwin & Barneby	Native		0.07	0.03
Tolumnia lemoniana (Lindl) Braem	Native	0.12		0.05
Turnera diffuse Willd.	Native	0.47	0.07	0.25
Colubrine elliptica (Sw .) Bricicky	Native	8.55	0.07	4.05
Guettarda macrocarpa Griseb.	Endemic	0.17		0.08
Casearia spinescens (Sw .) Griseb.	Native	0.06		0.03
Lantana camara L.	Native		0.07	0.03
Lantana involucrata L.	Native	1.16	0.73	0.82

Floristic similarity

17 % of the species are common in the three areas studied, the greatest similarity was between ABSM-PI and ABSM-TI (0.51), followed by ABSM-NI with respect to ABSM-PI (0.37) and ABSM-NI with ABSM-TI (0.08).

Some species increased their abundance in areas with greater coverage of the invasive species, such as *Croton. glabellus* subsp. *glabellus, Bourreria virgata, Vachellia macracantha* and *Exostema caribaeum*. Others decreased their abundance until presenting the lowest values in the areas with the highest levels of infestation, among them *Gynamthes lucida, Coccoloba diversifolia* , *Erythroxylum rotundifolium* , *Amyris elemifera* and the endemic *Eugenia iteophylla* , *Oplonia polyece* and *Maytenus buxifolia* subsp . *cochlearifolia.*

Floristic composition by strata

In the three study areas, the tree, shrub, herbaceous and liana strata were represented (Figure 1). Epiphytes were only recorded in ABSM-NI and ABSM-PI with three and two species, respectively, and *Tillandsia fasciculata* is the most abundant species.

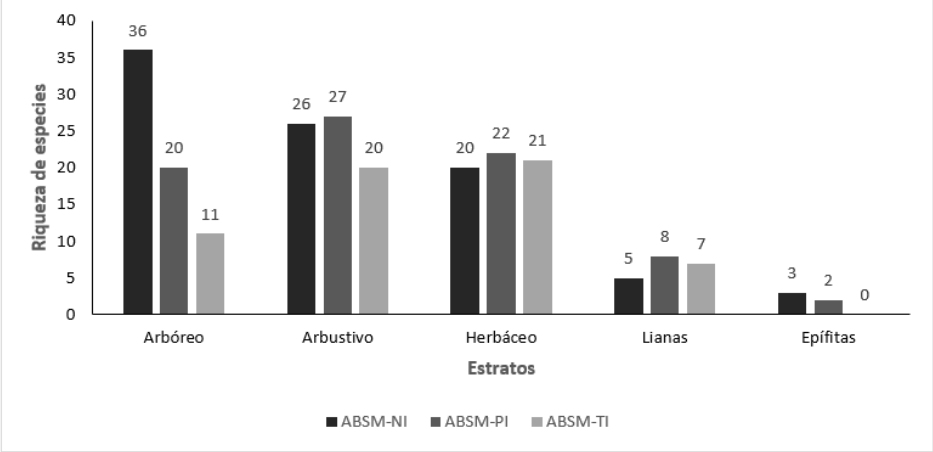

Figure 1. - *Species richness by strata in the microphyllous semi-deciduous forest areas studied in the Siboney- Juticí Ecological Reserve*

The results by area showed that in ABSM-NI the tree stratum cover was 75 to 87 %. Emergents up to 10 m in height were found, represented by *Bursera simaruba, Jacaranda coeroulea* and *Coccoloba diversifolia*. 36 species were determined, the most representative in terms of number of individuals per species: *Gymnanthes lucida* (40), *Erythroxylum confusum* (28), *Sideroxylon salicifolium* (17), *Coccoloba diversifolia* (15), and *Eugenia iteophylla* (9).

The shrub layer presented between 60 to 90 % coverage, in which 26 species were recorded, the most abundant of individuals *Erythroxylum confusum* (52), *Gymnanthes lucida* (46), *Eugenia iteophylla* (31) and *Coccoloba diversifolia* (17). The herbaceous layer was composed of 20 species where *Croton* seedlings predominated *glabellus* (30), *Gymnanthes lucida* (18), *Coccoloba diversifolia* (10) and *Eugenia iteophylla* (9). The values of the covered surface ranged between 10 and 40 %. The liana synucium was mainly represented by *Smilax havanensis* and *Stigmaphyllon sagranum*. The epiphytes found were *Tillandsia recurvata*, *T. utriculata* and *T. fasciculata* (species more abundant).

At ABSM-PI The tree cover was between 50 and 100%, with heights of up to 9 m. 21 species were identified, the most abundant of individuals being *L. leucocephala* (54), *Eugenia iteophylla* (35) and *Colubrina elliptica* (31). In the shrub layer, coverage ranged between 60 and 80%, with 35 plant species recorded, including *Croton. glabellus* subsp . *glabellus* (94), *L.*

leucocephala (68) and *Colubrina elliptica* (64). The herbaceous layer covered 10 to 50%, represented mostly by seedlings of 22 species common in the tree and shrub layers, such as *L. leucocephala* (910), *Croton glabellus* (75), *Colubrina elliptical* (52), *Guapira obtuse* subsp. *obtusata* (31) and *Eugenia iteophylla* (30). Among the typical species of this stratum, *Scleria lithosperma* dominated with 17 individuals; and among the lianas *Stigmaphyllon sagranum*, *Passiflora suberosa* and *Smilax havanensis* were recorded, the latter being the most abundant. In the case of epiphytes, isolated individuals of *Tillandsia were found fasciculata*.

The ABSM-TI had a tree cover between 60 and 100%, with individuals reaching 7 m in height. This stratum was represented by 11 species, dominated by *L. leucocephala* (129) and *Bourreria succulent* (10). The coverage of the shrub layer was between 45 and 100%, consisting of 34 species, with a predominance of *L. leucocephala* (91) and *Croton glabellus* (87). The herbaceous layer (10 to 40%) is composed of 21 taxa, with a high number of seedlings of *L. leucocephala* (891). 11 species of lianas were found, with a predominance of *Stigmaphyllon sagranum* and *Smilax havanensis*. No epiphytes were recorded. For the first time in these areas appear, *Annona squamosa Echites umbellatus* subsp. *umbellatus*, *Lantana camara*, *Lasiacis divaricata*, *Senna atomaria* , *Tecoma stans* and *Bourreria succulent* .

DISCUSSION

Species richness

The total number of recorded species represents 14% of the total reported for the Siboney-Juticí Ecological Reserve by Martínez and Alverson (2005). *Rubiaceae* and *Fabaceae* are found among the families with the highest number of species in agreement with what was reported by Martínez and Alverson (2005), Figueredo *et al.* (2011) and Reyes and Fornaris (2011) in the same reserve.

Species richness among the three sites was similar between 43 and 55 species; suggesting that the presence of *L. leucocephala* does not cause obvious variations in species richness, but rather in species composition and abundance/cover. In ABSM-PI and ABSM-TI, although some typical species of the microphyllous semi-deciduous forest persist, ruderal and segetal

species such as *Lantana camara, Annona squamosa, Turnera diffusa* and the poaceae *Ichnanthus pallens* and *lasiacis divaricata* ; which are only present in these areas.

The presence of ruderal species in the areas covered by *L. leucocephala* is based on the proximity of these areas to roads adjacent to the community "El Palenque" where some invasive, synanthropic and ruderal species are common, which favors their dispersion and spread in the reserve. This is consistent with the results of Martorano and Durigan (2010), Figueredo *et al.* (2011), Salmerón-López *et al.* (2016), who reported that these plants are easily established in already disturbed places; in this case, in sites where *L. leucocephala* is established and dominates in the three strata. On the other hand, similar results were obtained by Rodríguez-Cala and González-Oliva (2015) when studying the impact of the *Tithonia diversifolia* in invaded and non-invaded areas of the Topes de Collantes Protected Natural Landscape.

The results obtained related to the specific richness among the sites differ from those reported by Figueredo *et al.* (2011), where the highest richness is found in the most disturbed sites, and was attributed to the mixture of species corresponding to different successional stages. However, they are similar to those documented by Salmerón-López *et al* . (2015) where the lowest number of species is found in the most disturbed sites. The decrease in the specific richness of the tree stratum in the ABSM-TI could be explained by the dominance of *L. leucocephala*. A high seed production and rapid growth compared to native species characterize this species (Fuentes and González 2011).

Floristic composition by strata

In the ABSM-NI a low forest is recorded, coinciding with that reported by Reyes and Acosta (2011) for the semi-deciduous forest types that develop south of the Sierra Maestra; similar results are also reported by Figueredo *et al*. (2012) for this type of forest on the coastal terraces of the Baconao Biosphere Reserve. The maximum height of the emergents decreases as the cover of *L. leucocephala* increases, which could be interpreted as one of the effects of the species on the microphyllous semi-deciduous forest, similar to that reported by Reyes and Fornaris (2011) in the plant formation in Siboney.

Among the tree species present in the three areas evaluated, *Gymnanthes lucida*, *Bursera simaruba*, *Coccoloba diversifolia* , *Jacaranda caerulea*, *Erythroxylum rotundifolium* , *Eugenia monticola* , *Amyris elemifera* and *Sideroxylon salicifolium* stand out. The first three coincide with those cited by Salmerón-López *et al.* (2015 and 2016) as the most abundant species in the least disturbed sites.

In the ABSM-PI and ABSM-TI, *L. leucocephala* seedlings predominate, in addition to seedlings and juveniles of other species from higher strata, such as *Gymnanthes lucida*, *Croton glabellus* and *Coccoloba diversifolia*. This abundance of seedlings and the competition effect that invasive species exert on native species have been reported by Salmerón-López *et al*. (2016). The shrub layer remains the same and the greatest changes are observed in the tree layer and the emergent species.

The presence of epiphytes, in particular the abundance of *Tillandsia* spp. in the ABSM-NI and ABSM-PI, coincides with the results of Brooks *et al*. (2015) in their study of the synanthropic flora of the Baconao coastal terraces, where this group of plants are the least abundant and only recorded in plant formations where disturbance is low. In addition, this could be due to the permanence in the ABSM-NI and ABSM-PI of species such as *Guapira obtusata, Tabebuia myrtifolia, Randia aculeata*, *Buxus glomerata* and *Pseudocarpidium avicennioides* which are widely used as phorophytes for these species.

The species with the highest abundance for ABSM-NI are useful in restoration and rehabilitation processes of this ecosystem, given their competitive ability and functional characteristics, which has been demonstrated by Reyes and Fornaris (2011). Salmerón-López *et al.* (2016) refers to them as dominant, colonizing and stabilizing the microphyllous semi-deciduous forest, which is demonstrated by the fact that most of them prevail in the invaded forest, although represented by few individuals, such is the case of *Gymnanthes lucida* , *Erithalis fruticosa*, *Eugenia monticola* , some with conservation value such as the endemic *Eugenia iteophylla*, *Pseudocarpidium avicennioides*, *Diospyros grisebachii,* the latter being threatened, and the timber *Sideroxylon salicifolium* and *Coccoloba diversifolia.*

Juticí Ecological Reserve provides an overview of how problematic the introduction and proliferation of invasive exotic species is in protected areas and helps understand the vulnerability of ecosystems to colonization by *L. leucocephala*. The results of this work provide useful information for the management of the area's plant resources, which will facilitate the targeting of actions to control *L. leucocephala* and the selection of species useful for the restoration of managed ecosystems, which contributes to the conservation of endemic and native species and natural habitats present in the reserve. These are elements to be taken into account when developing management and operational plans for the protected area.

CONCLUSIONS

The presence of *Leucaena leucocephala* in areas of microphyllous semi-deciduous forest in the Siboney- Juticí Ecological Reserve reflects changes in the composition and abundance of species, specifically native and endemic ones.

In the areas with the highest coverage of the invasive species, there was a decrease in the specific composition of the tree stratum and an increase in the composition of the shrub and herbaceous strata. Epiphytes were only recorded in ABSM-NI and ABSM-PI.

The sites with the greatest *Leucaena coverage leucocephala* shows a decrease in the maximum height of emergent trees in the microphyllous semi-deciduous forest of the Siboney- Juticí Ecological Reserve.

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