UNIVERSITY EDITORIAL

Cuban Journal of Forest Sciences

CFORES

Volume 10, Issue 1; 2022

University of Pinar del Río "Hermanos Saíz Montes de Oca"

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ISSN: 2310-3469 RNPS: 2347
CFORES Journal, January-April 2022; 10(1):74-92

Translated from the original in spanish

Original article

Floristic composition and structure of a coastal and sub-coastal xeromorphic scrub in the semi-arid zone, Guantánamo

Composición florística y estructura de un matorral xeromorfo costero y subcostero en la zona semiárida, Guantánamo

Composição florística e estrutura de um impulso xeromórfico litoral e subcostaal na zona semiárida, Guantánamo

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Received :01/06/2021.
Approved: 03/29/2022.

ABSTRACT

According to the categorization of the World Wide Fund for Nature (WWF, for its acronym in English), xeromorphic scrublands are terrestrial ecoregions of importance for conservation. In order to characterize the floristic composition and structure of a coastal and subcoastal xeromorphic scrub, the following study was developed, at the "El Rosal" site located in the semi-arid zone of the Guantánamo province. Twenty sampling plots with an area of 20 x 25 m were established; the diameter (1.30) and height of all individuals e" 5 cm were recorded, the sampling was validated with the area-species curve. With the values obtained, the Shannon, equity and Simpson diversity indices and beta diversity were calculated through an analysis of hierarchical clusters, by means of the Sorensen distance measure, the horizontal structure and the vertical structure through the description of the strata. of the vegetation. A total of 15 species belonging to 10 genera and 11 families were recorded, where the species of greatest ecological importance were *Guaiacum officinale* L. and *Leucaena leucocephala* (Lam.) de Wit. In the cluster analysis, three clusters were distinguished with 63% similarity. Low floristic diversity was demonstrated and the vegetation reached up to 5 m in dominant height and the species with the highest sociological position were *Guaiacum officinale*, *Leucaena leucocephala* and *Azadirachta indica*.

Keywords: diversity, density, coastal forest, xerophytic vegetation and Imías.

RESUMEN

De acuerdo con la categorización del Fondo Mundial para la Naturaleza (WWF, por sus siglas en ingles), los matorrales xeromorfos son ecorregiones terrestres de importancia para la conservación. Con el objetivo de caracterizar la composición florística y la estructura de un matorral xeromorfo costero y subcostero, se desarrolló el siguiente trabajo en el sitio "El Rosal", ubicado en la zona semiárida de la provincia Guantánamo. Se establecieron 20 parcelas de muestreo con un área de 20 x 25 m; se registró el diámetro (1,30) y altura de todos los individuos e" 5 cm., el muestreo fue validado con la curva área-especie. Con los valores obtenidos se calcularon los índices de diversidad de Shannon, equitatividad y Simpson y la diversidad beta a través de un análisis de conglomerados jerárquicos, mediante la medida de distancia de Sorensen, la estructura horizontal y la estructura vertical mediante la descripción de los estratos de la vegetación. Se registraron un total de 15 especies pertenecientes a 10 géneros y 11 familias, donde las especies de mayor importancia ecológica resultaron: *Guaiacum officinale* L. y *Leucaena leucocephala* (Lam.) de Wit. En el análisis del conglomerado, se distinguieron tres agrupaciones con un 63 % de similitud. Se demostró la baja diversidad florística y la vegetación alcanzó hasta 5 m de altura dominante y las especies de mayor posición sociológica resultó *Guaiacum officinale, Leucaena leucocephala.* y *Azadirachta indica.*

Palabras clave: Diversidad; Densidad; Manigua costera; Vegetación xerófila e Imías.

RESUMO

De acordo com a categorização do World Wide Fund for Nature (WWF, na sigla em inglês), os cerrados xeromórficos são ecorregiões terrestres de importância para a conservação. Com o objetivo de caracterizar a composição e estrutura florística de um matagal xeromórfico costeiro e sub-costeiro, foi desenvolvido o seguinte trabalho, no sítio "El Rosal" localizado no semi-árido da província de Guantánamo. Foram estabelecidas 20 parcelas amostrais com área de 20 x 25 m; Foram registrados o diâmetro (1,30) e a altura de todos os indivíduos e" 5 cm, a amostragem foi validada com a curva áreaespécie. Com os valores obtidos, os índices de diversidade de Shannon, justiça e Simpson e diversidade beta foram calculados por meio de uma análise de clusters hierárquicos, por meio da medida de distância de Sorensen, a estrutura horizontal e a estrutura vertical por meio da descrição dos estratos. a vegetação. Um total de 15 espécies pertencentes a 10 gêneros e 11 famílias foram registradas, sendo as espécies ecológicamente mais importantes *Guaiacum officinale* L. e *Leucaena leucocephala* (Lam.) De Wit. Na análise de cluster, três clusters foram distinguidos com 63 % de similaridade. Foi demonstrada baixa diversidade florística e a vegetação atingiu até 5 m de altura dominante e as espécies com maior posição sociológica foram *Guaiacum officinale* L., *Leucaena leucocephala* (Lam.) De Wit. e *Azadirachta indica* A. Juss.

Palavras-chave: Diversidade; Densidade; Floresta costeira; Vegetação xerofítica e Imías.

INTRODUCTION

According to the World Wildlife Fund (WWF) categorization, xeromorphic shrublands are terrestrial ecoregions of conservation importance. These are areas with particular ecological, climatic and geomorphological characteristics and are considered of global conservation importance because, among other values, they harbor numerous flora and fauna endemisms, species with restricted distribution and high species richness (Mancina *et al.,* 2017). While biodiversity conservation in Cuba is a constant concern given the floristic richness and vulnerability of plant communities. Therefore, in the Red List of the Flora of Cuba (González-Torres *et al.,* 2016) they recognize the need for continuous monitoring of the flora that inhabits coastal xeromorphic scrublands, as they constitute ecosystems that are highly affected by climatic events and human action. Unfortunately, this richness has been diminished by different pressures, mainly generated by humans through the introduction of invasive species, deforestation, fragmentation, cattle ranching and poor agricultural management (Mancina and Cruz 2017).

Guantánamo province is not exempt from this situation, such is the case of the southern coastal area, where forests are scarce and sparse, a situation caused by indiscriminate logging in previous years for the construction of ships, houses and furniture; the expansion of livestock and the use of firewood for the sugar industry, domestic and artisanal uses (Fernández *et al*., 2018).

At present, there is little information on the floristic composition and structure of the coastal and subcoastal xeromorphic scrub located in this area, which, due to its importance for planning and the development of future management plans, is a task to be taken into account for the sustainable use of these ecosystems and their components. Therefore, the present work aims to characterize the floristic composition and structure of a coastal and subcoastal xeromorphic scrubland in the semiarid zone of Guantánamo.

MATERIALS AND METHODS

The work was carried out in the period from January 2018 to September 2019, in a coastal and subcoastal xeromorphic scrubland of the southern border, neighboring to La Chivera¢s location, a flat area near the coast in the Imías municipality of Guantánamo province.

The "El Rosal" site was selected, located between coordinates N-157.150-E-734.175, in stand 15, with an extension of 10 ha of lot 12, which belongs to the Cajobabo Silvicultural Unit of the Imías Agroforestry Company. It is bordered to the north by stand 4, to the south by the Caribbean Sea, to the west by stand 14 and to the east by stand 8, an area classified as a protective forest (Figure 1).

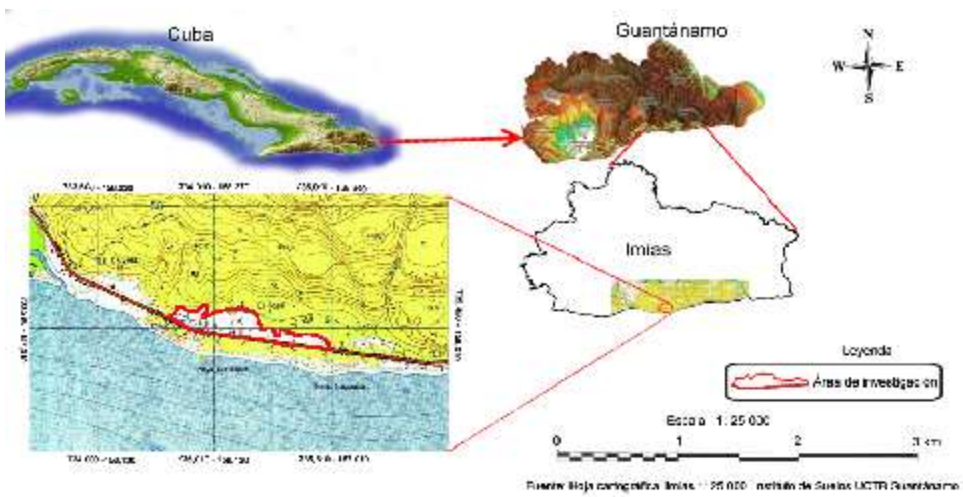

Figure 1. - Location of the work area at the El Rosal site

The average annual behavior of the main variables in the locality of La Chivera, it was observed that the temperature presented monthly averages ranging between 24.9 and 29.0ºC with an average annual value of 26.9ºC. It should be noted that the average maximum temperature values ranged between 28.4 and 32.1ºC.

For rainfall, an annual average of 559.6 mm was found, where only the months of May, August, September and October exceed 60 mm, the latter with an average above 100 mm. Relative humidity reaches average values between 73 and 78 % with an annual average of 76 %, maximum average of 88% and minimum average of 63 % (ISMET 2017).

We worked on a little evolved soil, type Lithosol Subtype háplico, genus dístrico, according to the new version proposed by Hernández *et al*., (2015), underlain by hard limestone, with depth of 5-18 cm, moderately gravelly (16-50 %), moderately stony (0.01-0.1 %), very strong erosion, slightly undulating slope (2.1-4.0 %).

For the characterization of the floristic diversity of the coastal and subcoastal xeromorphic scrubland, 20 rectangular plots of 20 x 25 m (500 m^2) were sampled, randomly distributed, following the guidelines of Malleux (1982). For the study of the tree mass, an inventory was carried out by simple random sampling. All individuals with diameter ≥ 5 cm at 1.30 m from the ground were measured and recorded (Aguirre 2019).

Taxa were identified directly in the field and doubtful ones were subsequently identified using dichotomous keys, herbarium materials, and botanical descriptions. Taxon names were revised according to Greuter and Rankin (2017).

The species present in the shrub and tree strata were measured for height (m), using a Sunnto hypsometer, and diameter (cm) with a diametric tape.

To determine whether the sampling effort was sufficient to adequately represent the study forest, the area-species curve was analyzed using the program BioDiversity Pro ver. 2 (Fernández *et al.,* 2018; García *et al*., 2020 and Rubio *et al.,* 2021).

Alpha diversity (α)

The diversity (alpha) of floristic species was determined using the methodology of Magurran (2004), through the richness index, Shannon-Wiener index (H), Simpsons index of species dominance (D) and the index of ecological importance value (IVIE).

Beta diversity (β)

For this study, a hierarchical cluster analysis was applied, using the Sorensen distance measure (Bray-Curtis) and the linkage method was the Group Average Link; the index varies from 0 (non-similarity) to 1.0 (complete similarity) (Magurran 2004).

The parameters of the horizontal structure were determined, through the calculation of the index value of ecological importance of the species, where IVIE= Relative abundance + Relative dominance + Relative frequency.

Vertical structure

The vertical structure was described taking into consideration the methodology of Acosta *et al.,* (2006), where they explain that the strata of the forest and the dominant species observed and recorded in each of them, explain that the low or herbaceous stratum to the species that were found from ground level is up to 2 m in height, in the middle or shrub stratum those found from 2.1 m and up to 6 m and in the high or arboreal stratum those found above 6 m.

To determine the position of the trees in the vertical plane, a phytosociological value was assigned to each substratum, which was obtained by dividing the number of individuals in the substratum by the total number of individuals of all species (VF=n/N). Where: VF= Phytosociological Value of the sub-stratum; n= number of individuals in the sub-stratum and N= total number of individuals of all species (Rodríguez 2015 and Rubio *et al.,* 2021).

The absolute value of the sociological position (PS) of a species was determined through the sum of its phytosociological values in each sub-stratum, by means of the product of the VF of the stratum considered by the number of individuals of the species in that same stratum: PSa= VF(i) *n(i) + VF(m)*n(m) + VF(s)*n(s), where PSa = Absolute sociological position; VF= Phytosociological value of the substratum; n = number of individuals of each species; i : lower; m: middle; s: upper. The relative sociological position (PSr) of each species was expressed as a percentage of the total sum of absolute values (Rodríguez 2015 and Rubio *et al.,* 2021).

RESULTS AND DISCUSSION

According to the area-species curve, the use of 20 sampling plots was sufficient to represent the floristic composition of the coastal and subcoastal xeromorph shrubland**.** It can be observed that from plot 15 onwards the asymptote in the curve is reached, where most of the species were identified in the first 14 plots, and from plot 15 onwards they remain constant. Taking into account the characteristics of the area where the study was carried out, it is very unlikely that new species will appear in environmental conditions with the same characteristics, so it can be said that from the floristic point of view the area reaches an equilibrium (Figure 2).

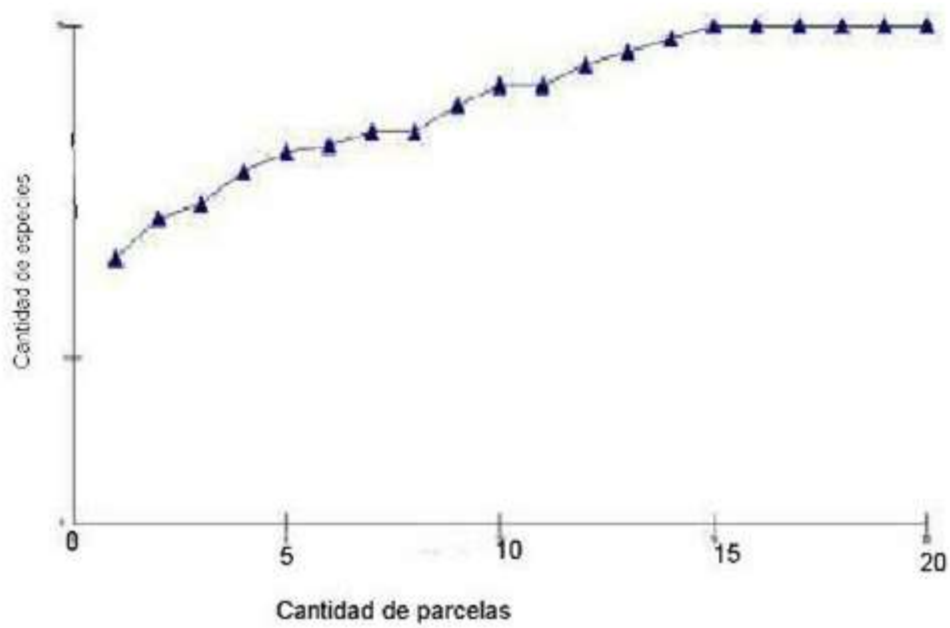

Figure 2. - Area-species curve obtained from the sampling in the scrubland. Coastal and subcoastal xeromorph at the site "El Rosal"

Similar results were found by García *et al*., (2020) in a coastal and subcoastal xeromorphic scrubland in the Baitiquirí Ecological Reserve, Guantánamo, where most of the species were identified from plot 22.

Beta diversity (α)

From the hierarchical cluster analysis based on the similarity between plots, three groups were identified within the coastal and subcoastal xeromorph shrubland with 63 % similarity (Figure 3), which correspond to vegetation that can be differentiated by their physiognomy, structure and location in the field, and not exclusively in relation to their floristic composition.

Group I is formed by plot 1 (red symbol) with 56 % similarity, group II has 65 % similarity and there are the plots (2, 4 a la 20) (blue symbol) and group III (green symbol) with 54% similarity represented by plot 3.

The area is generally characterized by the presence of trees and shrubs such as: *Guaiacum officinale* L., *Leucaena leucocephala* (Lam.) de Wit, *Caesalpinia glandulosa* Berter., *Azadirachta indica* A. Juss, *Bourreria virgata* (Sw.) G. Don. *Albizia cubana* Britton & P. Wilson in Britton & Rose (Barneby & J.W. Grimes), *Hebestigma cubense* (Kunth) Urb., *Brya microphylla* Bisse. *Lysiloma sabicu* Benth, *Lysiloma latisiliquum* (L.) Benth. In addition, the cactaceae *Stenocereus fimbriatus* Lam.

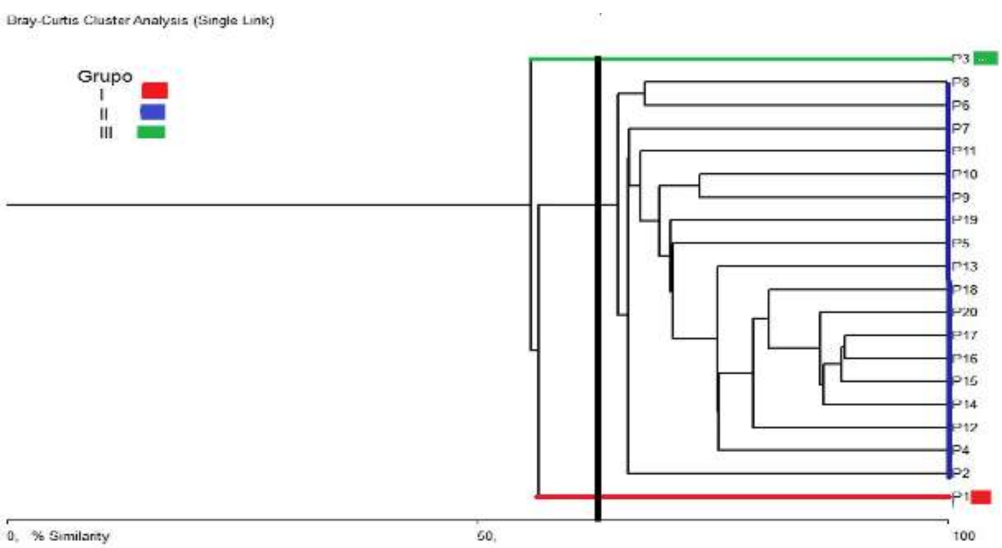

Figure 3. **-** Dendrogram of floristic similarity in the coastal xeromorphic scrubland and subcoastal in the site "El Rosal"

The coastal and subcoastal xeromorphic scrubland at the El Rosal site develops on bare or partially bare karst, with outcrops of dogtooth, the soil is skeletal, shallow, with carbonate rocks, It is located behind the coastal vegetation complex, rich in arborescent cacti and abundant shrub species Capote and Berazaín (1984), Borhidi (1996), Reyes et *al*., (2016), Hernández *et al*., (2018) and Vitlloch and León (2020).

Group I vegetation is not fragmented, sheep grazing is scarce, the soil is poorly evolved, moderately stony, slightly undulating, low effective depth and with leaf litter on the ground. The shrub vegetation is semi-dense, generally characterized by a greater presence of *A. indica*, *G. officinale, A. cubana, L. leucocephala*, *H. cubense, C. glandulosa, S. fimbriatus,* the herbaceous vegetation is seasonal with an abundance of grasses. In addition, this group, being far from the coast, is less influenced by the wind and is also farther from the road.

In group II, the forest is slightly fragmented, there is evidence of sheep grazing, forest clearings, roads and wood extraction for firewood. The soil is poorly developed, moderately stony and gravelly, with very strong erosion, low effective depth and a slightly undulating slope. It is characterized by a greater presence of *A. indica, A cubana, G. officinale, L. leucocephala, H. cubense, B. virgata, L. sabicu, C. glandulosa, S. fimbriatus*, and with a lower degree of anthropic disturbance. It has the highest similarity, due to the fact that these plots are located in areas with similar topographic characteristics and altitudinal gradient, and it was also the most diverse with nine species typical of this ecosystem.

In group III, the forest is fragmented, with intensive sheep grazing, forest clearings, roads and wood extraction for firewood. The soil is poorly developed, moderately stony and gravelly, with very strong erosion, low effective depth, presence of gullies and a slightly undulating slope. It is characterized by the presence of abundant herbaceous plants, with only two tree species in the plot: *L. leucocephala and A. indica. In* addition, this plot has many downed trees caused by Hurricane Mathew, such as *G. officinale* and *L. leucocephala*.

In general, the three groups share six species, although the species *L. sabicu is* found in low abundance and frequency in plots of group II. The species *L. leucocephala and A. indica* are the product of a plantation for soil formation, since the soil is not very evolved and has as a limiting factor the shallow effective depth.

There is also *Leucaena leucocephala* reported by Jiménez (2016) as invasive which can transform the structure of the forest, due to the damage they cause to those species that are around them and those that are regenerating.

Table 1 shows Sorensen's qualitative index, showing that groups I and II share 10 species for 80% similarity, because there are more common species than the sum between the two groups. Group I and III share 6 common species for 57 % and group II and III have 6 common species for 87 %. It is observed that groups I and II present the highest similarity values. Generally speaking, the three groups are very similar because the values are higher than 0.66, these results coincide according to Aguirre (2019). The common and most abundant forest species are: *A. indica, G. officinale*, and *L. leucocephala*.

Table 1. - Index of floristic similarity in the coastal and subcoastal xeromorphic scrubland at the El Rosal site

	Group 1	Group 2	Group 3
Group 1		80	67
Group 2	10		57
Group 3	6	6	

In general, all groups are anthropized by the unconscious action of man through habitat fragmentation by road construction, goat grazing and indiscriminate logging of some species for the economic value of their wood, for the construction of houses, poles and woodwork: *G. officinale, B. microphylla, A. cubana* and *L. sabicu.*

Alpha Diversity

Fifteen species, ten genera and nine families were identified in the area (Annex 1, Table 4); few in-depth floristic studies have been carried out in this site, only quick and preliminary inventories by specialists of the Empresa Agroforestal de Imías, which makes it difficult to obtain previous knowledge of the area's situation.

The most abundant family in relation to species richness groups most of the individuals listed (Figure 4), as is the case of the Fabaceae family (8). Similar results to those reported by Figueredo (2015) in the coastal scrub and semi-deciduous microphyllous forests of the Baconao Biosphere Reserve where he states that the most represented families are: Leguminosae, Malvaceae, Euphorbiaceae, Rubiaceae, Boraginaceae, Asteraceae, Poaceae and Convolvulaceae. García *et al*., (2020) explain that in studies of the diversity of the coastal and subcoastal xeromorphic scrubland in the Baitiquirí Ecological Reserve, Guantánamo, they reported that the most abundant families were: Apocynaceae, Boraginaceae, Bromelaceae, Caesalpinaceae, Euphorbiaceae, Fabaceae, Rutaceae, Malpighiaceae, and Rubiaceae.

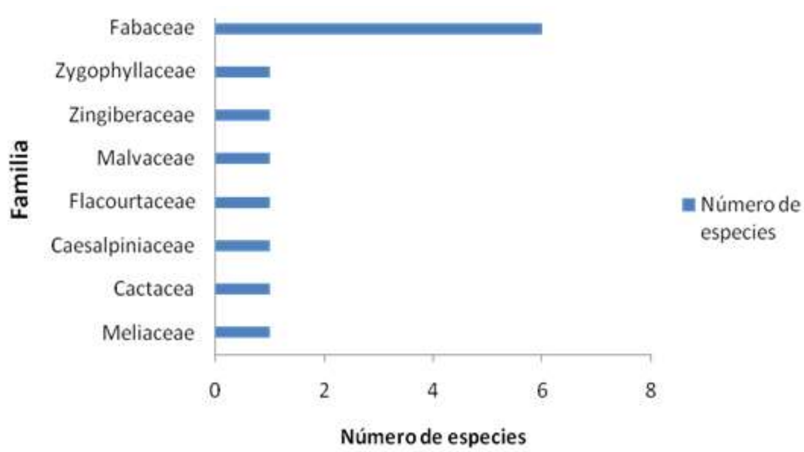

Figure 4. - Families with the highest species richness in the coastal xeromorphic scrubland and subcoastal at the "El Rosal" site

These results are in agreement with studies carried out in the coastal xeromorphic scrub in Caletón de Don Bruno, Cienfuegos, Cuba, where the families with the highest taxonomic richness were Fabaceae, Malvaceae, Poaceae, Rubiaceae and Euphorbiaceae (Vitlloch and León 2020).

The Fabaceae family was the most representative, coinciding with what was reported in the composition and diversity studies of the Tamaulipan thornscrub, Mexico by Graciano *et al*., (2018) and Valdez *et al*., (2018).

Figure 5 shows that the greatest number of individuals are found in the herbaceous stratum with 949, tree (133) and shrub (382). In the arboreal stratum, the most abundant species were A. *indica, A. cubana*, *G. officinale, L. leucocephala,* in the herbaceous stratum *Corchorus hirsutus* L*., Indigofera suffruticosa* Mill*, Ipomoea tuba* Schltdl*.* G. Don and *C. glandulosa* Berter, this is a major problem as it does not guarantee the perpetuity of the ecosystem. *S. fimbriatus* was the most represented of the succulent species.

However, García *et al*., (2020) state that in studies of a coastal and subcoastal xeromorphic scrubland in the Baitiquirí Guantánamo Ecological Reserve, there were 380 individuals in the herbaceous stratum, 813 individuals in the shrub stratum and 441 individuals in the tree stratum (Figure 5).

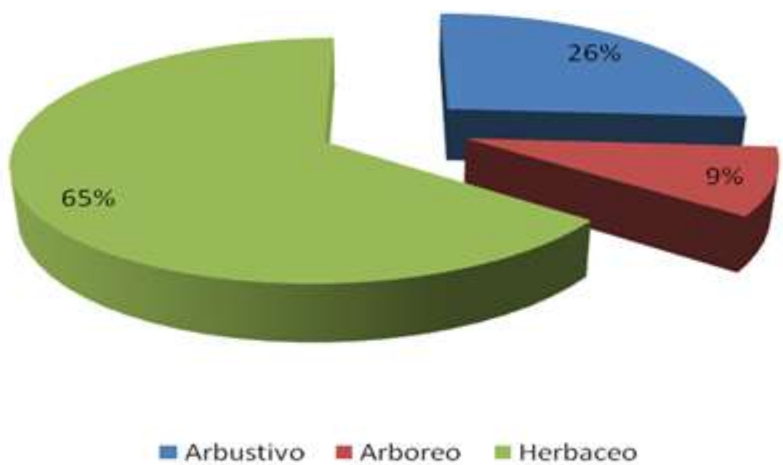

Figure 5. - Total number of individuals present in each stratum of the shrubland. Coastal and subcoastal xeromorph of the site "El Rosal"

Index of Ecological Importance Value (IVIE)

In the horizontal structure, the ecological importance value index was evaluated as shown in Figure 6*,* highlighting *L. leucocephala* and *G. officinale*, species that presented the highest values of abundance, frequency and dominance. The other species are evaluated as low, since they do not reach 22 %. The decrease in the number of individuals within the area could be associated with anthropogenic and natural disturbances. The species *A. indica* and *L. leucocephala* are considered invasive species according to Oviedo and González (2015) that have displaced the original vegetation, decreasing in composition and structure. Similar results reached Fernández *et al*., (2018) for the Los Cerezos site with similar vegetation and Figueredo (2015) in xeromorph shrublands of the Baconao Biosphere Reserve. Also, Vitlloch and León (2020) reported invasive species in their study of the vegetation in the Caletón de Don Bruno Cienfuegos. Similarly, Hernández, González and Tamayo (2018) found in study of the vegetation in Cabo Cruz, Desembarco del Granma National Park in the xeromorphic scrubland exotic and invasive species. The species *L. leucocephala,* despite being an invasive, also benefits the soil in aspects such as: increased nitrogen and organic matter content, increases the microorganisms that live in the soil, breaks up compacted strata, recycles nutrients from deeper layers by depositing them through its leaves and other parts of the plant, and improves water absorption. This plant has been used to rehabilitate sites where there was mining exploitation and degraded land (Rico 2017). The species *A. indica* has also been used under both monospecific and mixed planting arrangements for the recovery of degraded soils in dry areas. It has been used for the rehabilitation of degraded soils in the Middle Western Antioquia, Colombia (Flórez 2011) (Figure 6).

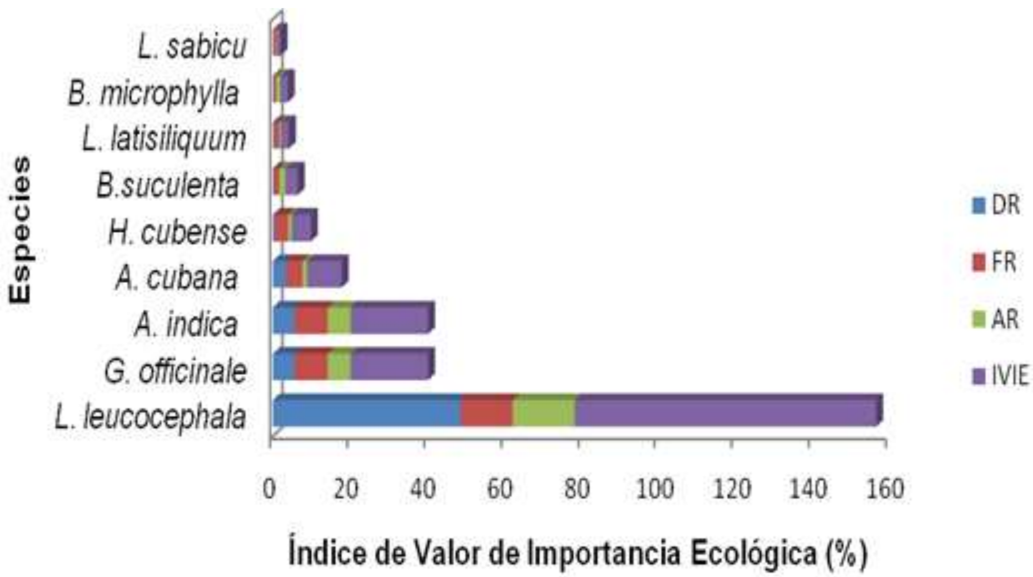

Figure 6.- Tree species with the highest IVIE in the coastal xeromorphic scrubland in the coastal and subcoastal in the site "El Rosal"

The dominant species are those that can reach the largest dimensions within the site and that can guarantee natural regeneration. The species *L. leucocephala,* and *G. officinale* is the second most important because it is a characteristic of this formation, so it could be considered for future reforestation plans or reestablishment of this type of forest that guarantees a greater probability of survival. These results coincide with those reported by García *et al*., (2020), who recorded *Phyllostylon brasiliense, Acacia farnesiana, Guaicum officinale, Cordia sulcata, Malachra alceifolia*, as the species with the highest value of importance when evaluating the composition and structure of the vegetation of a coastal and subcoastal xeromorphic scrub in the Baitiquirí Guantánamo Ecological Reserve.

The species with the lowest ecological importance value index: *B. microphylla, A. cubana, H. cubense, L. sabicu, L. latisiliquum*, have decreased in density, frequency and dominance in the area, being the most susceptible to natural or artificial disturbances. It should be noted that many of these species have been overexploited, coinciding with what was stated by Fernández *et al.* (2018), García *et al*., (2020), who state that species with low participation become vulnerable to natural and anthropogenic disturbances such as: cyclone action, forest fires, felling of trees to obtain forks, manufacture of housing, firewood, among others.

Diversity indexes

The behavior of the diversity indexes of the floristic species of the coastal and subcoastal xeromorphic scrub of the "El Rosal" site for each sampling unit is shown in Table 2, where 15 species were identified.

The Shannon-Wiener index (H) for the area is low, since, according to the evaluation, it is in the range of 0.73 to 0.98, with group I being the most abundant. Considering the equity, values between 0.86 and 0.94 are observed, which means that the area is homogeneous in abundance, where group I is the most homogeneous. The dominance index (D) for the area is low (0-0.33), coinciding with Aguirre (2019); ranging between 0.11 and 0.20, which shows that there is little dominance of one species over the others. Group I is the least dominant with an index of 0.11 and with a high diversity of 9.13, since they are inversely proportional, the following species stand out: *A. indica, G. officinale, A. cubana, L. leucocephala*, *H. cubense. C. glandulosa, S. fimbriatus*. Group III has the lowest diversity, the highest dominance, the lowest species proportional abundance and equity (Table 2).

Table 2. - Richness and diversity of woody species in the coastal xeromorphic scrubland and subcoastal on the site of "El Rosal"

Plots	Number		Indexes			
	Species	Individuals	H'	E	D	1/D
Group I	11	940	0,98	0,94	0,11	9,13
Group II	14	13980	0,75	0,91	0,19	5,39
Group III	7	640	0,73	0,86	0,20	4,93

Where:

- H' Shannon Hmax Species diversity index.
- E Equity Index.
- D Simpsons Diversity (D) Dominance index.
- 1/D Simpsons Diversity (1/D) Diversity index.

The behavior of diversity could be associated with the occurrence of disturbances (planting, introduced species), an effect that conditions an alteration in the composition, structure and number of individuals due to the appearance of pioneer and secondary species, which causes a decrease in the importance of native species (Figueredo 2015). Similar results coincide with Aguirre (2019) in stating that his preference to establish evaluations by Simpson's index, which considers species dominance and offers information about the probability that two individuals extracted at random belong to different species, being less sensitive to species richness. In similar studies Fernández et al. (2018) reported the low behavior of floristic species diversity indices in the xerophytic forest in the Los Cerezos area, Imías.

However, Valdez *et al*., (2018) and Graciano *et al*., (2018) reported that in the studied area of the Tamaulipan¢s thorn scrubland it presents a high specific richness and diversity of arboreal, shrub and succulent species compared to other plant associations of the northeastern Mexican scrubland.

Vertical structure

The vegetation reached up to 5 m of dominant height (Figure 7) with *A. indica* and *L. leucocephala* standing out as emergent trees from 6 to 8 m in height*;* these are not species typical of this ecosystem, they are invasive (Oviedo 2015). In this regard, Capote and Berazain (1984), Borhidi (1987), Borhidi (1996) and Vitlloch and León (2020) state that this type of vegetation consists of a dense shrub layer, between 2-3 m high and in extreme places up to 6-8 m high.

In similar studies, Figueredo (2015) states that in the coastal and subcoastal scrubland in the Baconao Biosphere Reserve, these forests generally have two strata, although with an irregular structure, reaching 6 m in height. Reyes, Portuondo and Fornaris (2016) also agree on the vertical structure of the vegetation of the coastal and pre-coastal scrubland in the coastal terraces of the southern Sierra Maestra, Santiago de Cuba where a shrubby, xeromorphic, sclerophyllous forest predominates with two strata and the arboreal reaches a height of 5 to 8 m.

Similarly, García *et al*., (2020) obtained in the vertical structure of the coastal and subcoastal xeromorphic scrub in the Baitiquirí Ecological Reserve, San Antonio del Sur, Guantánamo where the predominant height was 4 m.

Hernández *et al*., (2018) reported in a study of the vegetation in Cabo Cruz, Desembarco del Granma National Park in the xeromorphic scrubland a stunted, sclerophyllous and xeromorphic shrub layer of 1 to 2 m in height, towards the interior of the scrubland, tree layers of 2 to 5 m in height are observed, with the presence of isolated emergent trees that rarely exceed 6 m in height.

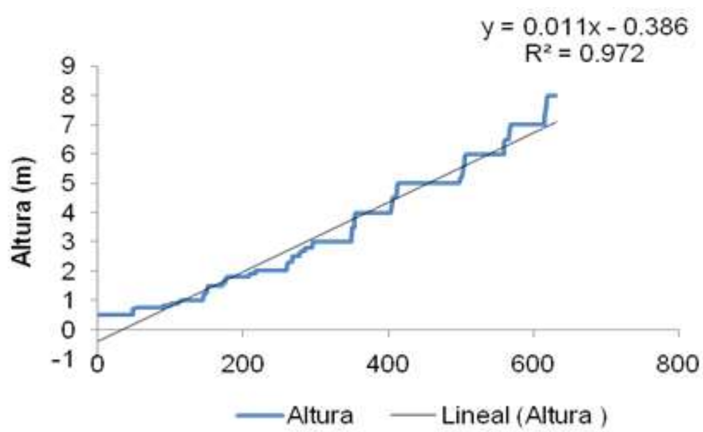

Figure 7. - Total heights of the species of the xeromorphic scrub strata coastal and subcoastal in the site "El Rosal"

The diagram in Figure 7 shows a strong relationship between the ratio of total heights and for all individuals in the strata, adjusted to a linear regression model with $R^2= 0.97$. The behavior of the trees describes a continuous stratum, with concentration in the lower stratum (0 - 2 m) (Figure 7).

Sociological position (PS)

The sociological position of the arboreal component in the coastal and subcoastal xeromorphic scrub at the "El Rosal" site, three strata were defined, including nine species, present in the lower and middle stratum and five in the upper stratum (Table 3).

Table 3. - Sociological position of the arboreal component in the xeromorphic shrubland coastal and subcoastal at the "El Rosal" site

	Lower Stratum (0-2 m)			Middle stratum (2,1-6,0 m)			Upper stratum (>6 m)					
Species	n/ha	Vfi	n(i)*vf(i)	n/ha	VF	n(m)*vf(m)	n/ha	VF	n(s)*vf(s)	N/ha	PSA	PSR (%)
A. indica	32	6	192	52	3	156	25	1	25	109	373	12,04
A. cubana	4	6	24	15	3	45	0	1	0	19	69	2,22
H. cubense	12	6	72	4	3	12	1	1	1	17	85	2,74
B. microphyla	12	6	72	6	3	18	0	1	0	18	90	2,90
G. officinale	183	6	1098	55	3	165	0	1	0	238	1263	40,76
L. leucocephala	139	6	834	52	3	156	25	1	25	216	1015	32,76
B. suculenta	13	6	78	8	3	24	0	1	0	21	102	3,29
L. sabicu	1	6	6	7	3	21	2	1	2	10	29	0,93
L. latisiliqum	5	6	30	12	3	36	6	1	6	23	72	2,32
Total	401		2406	211		633	59	1	59	671	3098	100

Legend: PSa: absolute sociological position**, PSr:** relative sociological position**, n:** number of trees in the stratum, vfi: phytosociological value of the stratum, i: lower; m: medium; s: upper

Of the three strata analyzed, the one that has had the greatest impact on the sociological position is the herbaceous stratum, followed by the shrub stratum, due to the fact that a greater number of individuals have been detected in these strata. Among the species found in the three strata are: *H. cubense*, *L.* latisiliqum*, L. sabicu, A. indica* and *L. leucocephala,* thus guaranteeing, according to Acosta *et al*., (2006), their place in the structure and composition of the forest.

Limeres *et al.,* (2015) describe some of the conditions present in the xerophytic forest of the semiarid zone that affect the regeneration of some species, such as low rainfall, grazing by goats that consume the fruits that are the basis of regeneration, physiognomy of the terrain where the seeds fall which determines the remanence of moisture, a limiting factor in this locality.

Norden (2014) states that edaphic factors can have a more important effect than light on the spatial distribution of species in tropical forests, among the most important soil characteristics are: the availability of assimilable phosphorus and nitrogen, pH and water availability, which in turn depends on the porosity of the soil and the depth of the water table. Also, the ability to compete with others for the availability of resources as referred by Muñoz (2017), knowing that competition can affect the dynamics of competing species and this dynamics in turn can influence the distribution of species and their evolution.

Of the species present in the lower stratum, 100 % are shared by the middle stratum and 55 % by the upper stratum, and only five species have a continuous vertical distribution, which responds to the different light requirements of the species.

This behavior could be related to the light requirements of some of the species since, according to Muñoz (2017), certain species can germinate under the canopy and their seedlings can establish and grow, while others need more solar radiation for their growth.

The lower and middle stratum is made up of *A. cubana*, *H. cubense, B. microphyla, G. officinale, B. suculenta, L. sabicu*, *L. latisiliqum*, *A. indica, L. leucocephala*. In the upper stratum stand out the individuals of *H. cubense*, *L. latisiliqum*, *L. sabicu, A. indica, L. leucocephala*.

The species *G. officinale (*40.76)*,* stands out as the one with the highest sociological position coinciding with one of the species with the highest index of ecological importance value, followed by *L. leucocephala* (32.23) and *A. indica* (12.04) shows the highest abundance in the lower and middle strata (between 0 and 6 m).

The same is not true for species such as *L. sabicu, L. latisiliqum, H. cubense, B. succulenta, B. microphyla, and A. cubana* with lower density, although the last three are not found in the upper stratum and did not present a continuous vertical distribution, which possibly will not allow them to persist among the dominant species of the future tree stratum.

CONCLUSIONS

Floristic diversity in the area is low, where the family with the highest species richness was Fabaceae and the species *L. leucocephala* and *G. officinale* were the most ecologically important.

The vertical structure is made up of three strata where the species with the highest sociological position were: *G. officinale, L. leucocephala* and *A. indica*, and the lower and middle strata showed the highest abundance.

Annexes:

Annex 1

Table 4. - List of species inventoried in the coastal xeromorph shrubland

Scientific name	Species	Family
***Albizia cubana* Britton & P. Wilson in Britton & Rose (Barneby & J.W. Grimes)**	Bacona	Fabaceae
***Azadirachta indica* A. Juss.**	Árbol del Neen	Meliaceae
***Bourreria virgata* (Sw.) G. Don**	Raspa lengua	*Borraginaceae*
***Brya microphylla* Bisse.**	Granadillo	Fabaceae
***Caesalpinia glandulosa* Bertero ex DC.**	Rosa brava	Fabaceae
***Corchorus hirsutus* L**	Malva	Malvaceae
***Guaiacum officinale* L.**	Guayacán	*Zygophyllaceae*
***Hebestigma cubense* (Kunth) Urb**	Frijolillo	Fabaceae
***Indigofera suffruticosa* Mill**	Añil cimaron	Fabaceae
***Ipomoea tuba* Schltdl G. Don**	Tuba tuba	Zingiberaceae
***Leucaena leucocephala* (Lam.) de Wit**	Lipi lipi	Fabaceae
***Lysiloma latisiliquum* (L.)Benth**	Soplillo	Fabaceae
***Lysiloma sabicu* Benth**	Sabicu	Fabaceae
***Stenocereus fimbriatus* (Lam.)**	Cactus	Cactaceae
***Sida glutinosa* Cav.**	Malva bruja	Malvaceae

REFERENCES

ACOSTA, VICTOR, H., ARAUJO, PUBLIO, A. y ITURRE, M., 2006. *Caracteres Estructurales. Serie Didáctica No 22* [en línea]. S.l.: Universidad Nacional de Santiago del Estero. [Consulta: 9 marzo 2020]. ISBN 978-987-1676-34-7. Disponible en: https://fcf.unse.edu.ar/archivos/series-didacticas/SD-22-Caracteres-estructurales-ACOSTA.pdf.

AGUIRRE, Z., 2019. *MÉTODOS PARA MEDIR LA BIODIVERSIDAD* [en línea]. Ecuador: Universidad Nacional de Loja. [Consulta: 9 marzo 2021]. ISBN 978-9942-36-127-1. Disponible en: https://www.academia.edu/43784264/M%C3%89TODOS_PARA_MEDIR_LA_BIODIVERS%20IDAD.

BORHIDI, A., 1991. *Phytogeography and Vegetation Ecology of Cuba* [en línea]. Budapest. Hungría: Akadémiai Kiadó. ISBN 978-963-05-5295-0. Disponible en: https://books.google.com.cu/books/about/Phytogeography_and_Vegetation_Ecology_of.html?id=8IolAQAAMAAJ&redir_esc=y.

CAPOTE, R.P. y BERAZAÍN, R., 1984. CLASIFICACIÓN DE LAS FORMACIONES VEGETALES DE CUBA. *Revista del Jardín Botánico Nacional* [en línea], vol. 5, no. 2, pp. 27-75. [Consulta: 30 marzo 2022]. ISSN 0253-5696. Disponible en: https://www.jstor.org/stable/42596743.

FERNÁNDEZ BETANCOURT, I., BLANCO IMBERT, A., CINTRA ARENCIBIA, M., FUENTES QUINTANA, J., CASTILLO DURAN, A. y GONZALEZ VILLAVERDE, R., 2018. "Propuesta de programa de restauración ecológica para sitios degradados en la zona semiárida de la provincia de Guantánamo". Informe final del proyecto PN P211LH005-023. Cuba, Guantánamo: Instituto de suelos, UCTB Guantánamo. Inédito.

GARCÍA-LACERA, Y., LEYVA-MIGUEL, I. y CÉSPEDES-CORREA, G., [sin fecha]. Diversidad florística del Matorral Xeromorfo Costero y Subcostero de la Reserva Ecológica Baitiquirí. *Hombre, Ciencia y Tecnología* [en línea], vol. 24, pp. 99-106. [Consulta: 30 marzo 2022]. Disponible en: http://portal.amelica.org/ameli/jatsRepo/441/4411976013/html/index.html.

GREUTER, W. y RANKIN, R., 2017. *Plantas Vasculares de Cuba Inventario preliminar. Actualizada, de Espermatófitos de Cuba con inclusión de los Pteridófitos. [en línea].* [en línea]. Segunda edición. Berlín, Alemania & La Habana, Cuba: Botanischer Garten & Botanisches Museum Berlin-Dahlem & Jardín Botánico Nacional, Universidad de La Habana. [Consulta: 7 julio 2021]. Disponible en: http://portal.cybertaxonomy.org/floracuba/cdm_dataportal/taxon/efaa10ae-cdef-40e5-a373-2ce4a32c0778.

HERNÁNDEZ, A., PÉREZ, J.M., BOSCH., D. y CASTRO, L., 2015. *Clasificación de los Suelos de Cuba*. Mayabeque, Cuba: Ediciones INCA.

ISMET, 2017. Caracterización climática de la zona de la Chivera. Guantánamo: ISMET.

JIMÉNEZ, M., 2016. *Desarrollo de metodología de teledetección para la distribución espacial de la plaga marabú (Dichrostachys cinerea) en Trinidad-Valle de los ingenios (Patrimonio Cultural de la Humanidad-Unesco)* Cuba: Instituciones Universidad Internacional de Andalucía; Universidad de Huelva. Edición electrónica. ISBN 978-84-7993-722-5.

LIMERES, T., BORGES, O., MARIANELA., C., FERNÁNDEZ, ILLOVIS., BLANCO, A., AGUILAR, YULAIDIS., SALLES, M.E., PONS, BLANCA, YUDITH., BAZA, R. y VERANES., EDITH., 2015. Experiencias y desafíos. Área de intervención Guantánamo Informe final Proyecto 1 OP-15 "Manejo Sostenible de Tierras. [en línea]. La Habana, Cuba: Edit. AMA. Disponible en: http://repositorio.geotech.cu/xmlui/handle/1234/2719.

MAGURRAN, A.E., 2013. *Measuring Biological Diversity* [en línea]. S.l.: John Wiley & Sons. ISBN 978-1-118-68792-5. Disponible en: https://books.google.com.cu/books/about/Measuring_Biological_Diversity.html?id=fIjsaxmL_S8C&redir_esc=y.

MALLEUX ORJEDA, J., 1982. *Inventarios forestales en bosques tropicales.* [en línea]. Lima: Universidad Nacional Agraria, 1982. Disponible en: https://www.worldcat.org/title/inventarios-forestales-en-bosques-tropicales/oclc/708730739.

MANCINA, C., FERNÁNDEZ, R., CRUZ FLORES, D., COLOMÉ, M. y GONZÁLEZ ROSSELL, A., 2018. Diversidad Biológica terrestre de Cuba. En: C.A. MANCINA y D.D. CRUZ FLORES (eds.), *Diversidad biológica de Cuba: métodos de inventario, monitoreo y colecciones biológicas* [en línea]. La Habana. Cuba: Editorial AMA, pp. 502. Disponible en: http://repositorio.geotech.cu/jspui/bitstream/1234/1454/3/008-025_Libro_Biodiversidad_Cuba_Cap%C3%ADtulo%202.pdf.

MUÑOZ, J., 2017. Regeneración Natural: Una revisión de los aspectos ecológicos en el bosque tropical de montaña del sur del Ecuador. *Bosques Latitud Cero* [en línea], vol. 7, no. 2. [Consulta: 30 marzo 2022]. ISSN 2528-7818. Disponible en: https://revistas.unl.edu.ec/index.php/bosques/article/view/326.

NORDEN, N., 2014. Del Porqué La Regeneración Natural Es Tan Importante Para La Coexistencia De Especies En Los Bosques Tropicales. *Colombia Forestal* [en línea], vol. 17, no. 2, pp. 247-261. [Consulta: 30 marzo 2022]. ISSN 0120-0739, 2256-201X. Disponible en: https://www.redalyc.org/articulo.oa?id=423939663008.

PRIETO, R., OLIVER, P., CALUFF, M., REGALADO, L., VENTOSA, I., PLASENCIA FRAGA, J., BARÓ, I., GONZÁLEZ GUTIÉRREZ, P., PÉREZ-CAMACHO, J., GONZALEZ-OLIVA, L., GUERRA, L., SOROA, J., TERÁN, S., ECHEVARRÍA, R., FUENTES MARRERO, I., ANGULO, R., RODRÍGUEZ VÁZQUEZ, P., MAYEDO, W. y CRUZ, M., 2012. Lista nacional de especies de plantas invasoras y potencialmente invasoras en la República de Cuba-2012. *Bissea* [en línea], vol. 6, no. 2, pp. 22-112. Disponible en: http://repositorio.geotech.cu/jspui/bitstream/1234/1476/4/Lista%20nacional%20de%20plantas%20invasoras%20de%20Cuba-2015.pdf.

REYES, O.J., NOVOA, E.V., FERRER, E.P. y GÓMEZ, E.F., 2016. CARACTERÍSTICAS FISONÓMICAS Y FUNCIONALES DEL MATORRAL COSTERO Y PRECOSTERO, COSTA SUR ORIENTAL, CUBA. *Foresta Veracruzana* [en línea], vol. 18, no. 2, pp. 37-44. [Consulta: 30 marzo 2022]. Disponible en: https://www.redalyc.org/journal/497/49748829005/html/.

RUBIO-RODILES, L., FERNÁNDEZ-BETANCOURT, I., BLANCO-IMBERT, A., FERNÁNDEZ-VELAZQUEZ, A. y BOROT-NUÑEZ, Y., [2021]. Diversidad florística de un bosque semideciduo micrófilo en municipio Imías, Guantánamo. *Hombre, Ciencia y Tecnología* [en línea], vol. 25, no. 1, pp. 102-111. [Consulta: 30 marzo 2022]. Disponible en: http://portal.amelica.org/ameli/jatsRepo/441/4412169014/.

VITLLOCH RAMOS, A.L., LEÓN CABRERA, J., VITLLOCH RAMOS, A.L. y LEÓN CABRERA, J., 2020. Flora y vegetación del caletón de Don Bruno, Cienfuegos, Cuba. *Centro Agrícola* [en línea], vol. 47, no. 4, pp. 42-53. [Consulta: 30 marzo 2022]. ISSN 0253-5785. Disponible en: http://scielo.sld.cu/scielo.php?script=sci_abstract&pid=S0253-57852020000400042&lng=es&nrm=iso&tlng=es.

Conflict of interests:

The authors declare not to have any interest conflicts.

Authors' contribution:

The authors have participated in the writing of the work and analysis of the documents.