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# *Estructura y composición florística del bosque xerofítico siempre verde costero en la Reserva Ecológica Baitiquirí Structure and floristic composition of the coastal evergreen xerophytic forest in the Baitiquirí Ecological Reserve*

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## Resumen

La investigación se realizó en la Reserva Ecológica de Baitiquirí con el objetivo de caracterizar la estructura y composición florística de estos bosques que se encuentran afectados por un incendio forestal. Permitió levantar 10 parcelas de 100 $m^2$ (10 x 10 m) de forma aleatoria, donde se contabilizó las especies florísticas, altura y diámetro. Se obtuvo un total de 27 especies pertenecientes a 23 géneros y 14 familias. La abundancia proporcional y la dominancia de especie son bajos, con una alta diversidad, la estructura de la comunidad puede considerarse normal, lo que garantiza la estabilidad del bosque.

**Palabras clave:** Diversidad, Reserva, Bosque, Especie, Incendio forestal.

## Abstract

The research was carried out in the Baitiquirí Ecological Reserve with the objective of characterizing the structure and floristic composition of these forests affected by a forest fire. Ten plots of 100 m2 (10 x 10 m) were randomly selected, where floristic species, height and diameter were counted. A total of 27 species belonging to 23 genera and 14 families were obtained. The proportional abundance and species dominance are low, with a high diversity, the community structure can be considered normal, which guarantees the stability of the forest.

**Keywords:** Diversity, Reserve, Forest, Species and forest fire.

# Introduction

Fortunately, the importance of forests has long been recognized by all. These complex terrestrial ecosystems are an integral part of the Earth's life support systems and play an important role in regulating the atmosphere and climate. However, an estimated loss of millions of hectares of forests worldwide has been recorded in recent years, demonstrating that the rate of loss is increasing.

Deforestation and forest degradation are urgent issues related to forests around the globe, with about 47% of the world's forests facing a high risk of deforestation or degradation by 2030. While both damage forest health, there is a difference between deforestation and forest degradation.

There are drivers of forest degradation, one of which is climate change - higher temperatures and unpredictable weather patterns increase the risk and severity of forest fires, pest infestation and disease - but the main cause of forest degradation is unsustainable and illegal logging, a multi-billion dollar industry based on the growing demand for cheap wood, paper products and fuels.

The role of fire in vegetation is ambivalent; in some ecosystems natural fires are essential to maintain their dynamics, biodiversity and productivity. Fire is also an important and widely used tool to achieve land management objectives. However, every year fires destroy millions of hectares of forests and other vegetation, causing the loss of many human and animal lives, causing immense economic damage, both in terms of resources destroyed and the costs of extinction. There are also impacts on society and the environment, for example, damage to human health from smoke, loss of biodiversity, emission of carbon dioxide (CO2) and other greenhouse gases, damage to recreational values and others, according to FAO data (2019).

Special attention should be paid to planning certain agricultural activities, for example, agricultural burning should take place before the dry season and before the surrounding landscapes in turn, are prone to fire. Burning should also be avoided during strong winds and the hottest time of the day. At the same time, alternatives to agricultural burning could be developed.

Local populations should be involved through participatory approaches, as they are often the main actors in landscape management, are directly affected by fires that threaten their livelihoods and may also be involved in some of the causes of the fire.

Protected areas are territories that, according to legislation, are especially consecrated to the protection of the original values of biological diversity, landscapes and the cultural heritage associated with these, unlike conservation ways, these try to maintain the values of the natural heritage in the very site where they treasure the most representative and outstanding species of the nation, according to data from CITMA (2004).

Cuba has 211 protected areas, representing 21% of the entire archipelago, 25.51% of the insular marine platform and 17.80% of the land area.

The Baitiquirí Ecological Reserve is one of these protected areas in Guantánamo province, it has an important number of species of flora and fauna, a high percentage of endemism and endangered species, which is important for the economy, not only as a source of timber supply and other resources, but for its role in nature conservation, especially biodiversity and soils, thus declared by MINAG (2014).

The main environmental problems that have contributed to the deterioration of the area are the occurrence of forest fires due to the extreme weather conditions in the area, as well as human-caused fires, which cause considerable losses in biodiversity and ecosystems that can be irreversible, causing the extinction of numerous endemic species, leading to an ecological imbalance that can be significant in environmental terms, according to PMREB (2014).

It is important to know the impacts caused by fires in these ecosystems in order to plan an adequate management of them. Therefore, this study aims to characterize the structure and floristic composition of the coastal evergreen xerophytic forest in the Baitiquirí Ecological Reserve.

# Development

The study area is located between the cartographic coordinates N148, 462 - 157,300 and E699, 612 - 711,800, belonging to the semi-arid zone of the San Antonio del Sur municipality of Guantánamo province, which is characterized by low average annual rainfall (less than 800 mm), relative humidity below 85 %, average annual evaporation of 2200 mm and an average annual temperature higher than 26 0C.

The fire occurred in May 2015. Considering the slow recovery of this forest type a second evaluation of fire effects was made in November 2017.

The average annual temperature is 25.45 ºC and average rainfall is 756.3 mm per year. The driest months are from November to mid-April and then July, the rainiest months are August and October. In general, it is characterized by a dry climate.

The sialytic brown soils are based on hard limestone and carbonate sandstone, of little effective depth, 28 cm, moderately humified 2.5 %, of strong erosion, sandy texture, with high amounts of coarse elements such as excessive stoniness, 80 % and rocky 15 %, the slope is somewhat unstable, from light 3 % to wavy 7 %, according to the new version of the soil classification given by Hernandez, et al. (1999).

The experiment was carried out in a burned area of 4.99 ha, in which a total of 10 plots of (100 m2) were raised two years and six months after the occurrence of the forest fire, randomly distributed in the area, counting the floristic species present in the different strata according to Alvarez and Varona (2006): herbaceous (0 to 1 meter in height), shrub (1 to 5 meters in height), arboreal (greater than 5 meters in height), the species present in the shrub and arboreal strata were measured for height (h) which was determined by visual appreciation and diameter (d) with a diametric tape. There was a floristic inventory of the burned area according to Hernández (2015), which was used to determine the degree of affectation to the flora after the occurrence of the forest fire.

To determine if the sampling effort was sufficient to adequately represent the community, the species richness curve was analyzed, where the accumulated number of new species per plot is related, this is the so-called "collector curve", using the Biodiversity McAleece, (1997).

The number of species and individuals per species, per plot and per family present in the area was determined. The diameter, height and basal area per hectare were determined. Species diversity and biological types were also evaluated. The horizontal and vertical structure, relative abundance (RA), relative frequency (RF), relative dominance (RD) and the index of ecological importance value (IVIE), according to Lamprecht (1990), were determined.

The sampling units or plots that were collected are representative of the species diversity of the coastal and coastal evergreen forest in the Baitiquirí Ecological Reserve, according to the area-species curve, Figure 1, where the asymptote is reached from plot 8, indicating that most of the species were identified in these plots. Considering the characteristics of the area where the study

was conducted, it is unlikely that new species will appear in environmental conditions with the same characteristics.

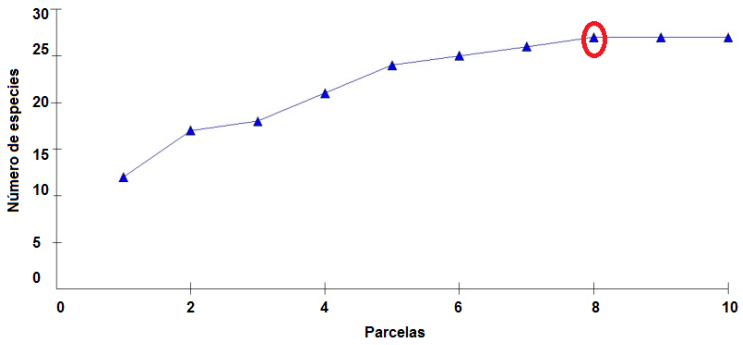



Figure 1. Species area curve obtained from sampling.
Source: Self elaboration

**Floristic composition**

A total of 400 individuals, 14 families, 23 genera and 27 species were identified in the area. However, in the control area a total of 5,708 individuals belonging to 36 families, 43 genera and 46 species were identified, which shows that after the fire the natural regeneration of most species is low.

These results, compared with the control area, show that the number of species found in the area before the fire decreased considerably, due to the great affectations and the impact of this phenomenon.

The most abundant families in relation to species richness, Figure 2, which group most of the individuals listed, as is the case of the Zigofilaceae family with two species and 19 individuals, the Malvaceae with five species and 90 individuals, the Fabaceae with two species and 12 individuals, unknown with six species and 77 individuals, other families with seven species and 85 individuals respectively.

On the other hand, other families were found to be represented by only one species: Cactaceae, Esterculiaceae, Poaceae, Euphorbiaceae, Mimosaceae, Rhamnaceae, Malpighiaceae, Apocynaceae and Aracaceae.

Similar results were obtained by Berazaín (2011), when he made it clear that in the classification of the forests of Cuba, the most represented families are the Cactaceae, Mimosaceae and Euphorbiaceae, since this type of formation is not very abundant.

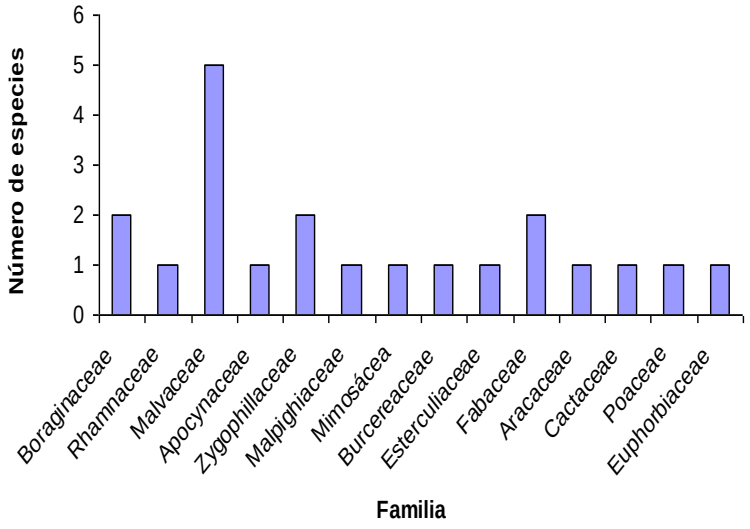



Figure 2. Most representative families in the study area.

Source: Self elaboration.

Figure 2 shows the life forms of the species present in the area, where 73% corresponds to Nanophanerophytes, 18% to herbaceous Epiphytes, 5% to herbaceous Lianas and 4% to Micronanofanerophytes.

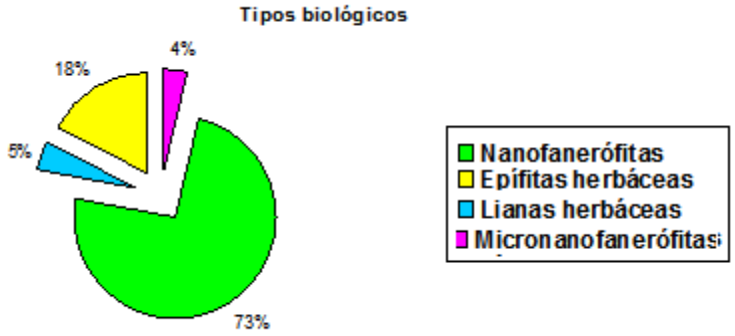



Figure 3. Life forms of the floristic species

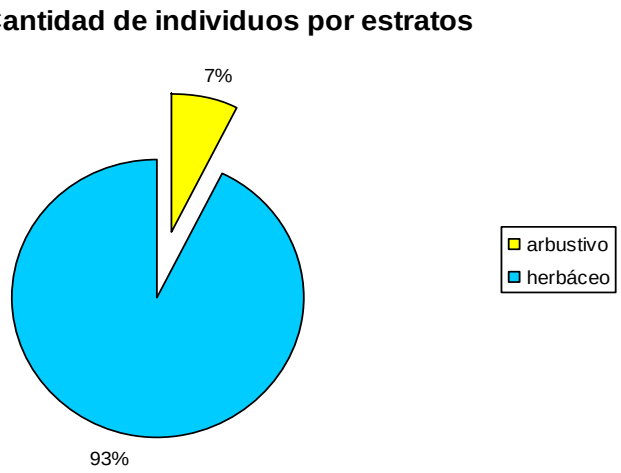
Source: Self elaboration

Berazaín (2011) agrees with these results, stating that in this formation there is a high percentage of nanophanerophytes (73%) compared to the other plant formations in Cuba, with 0.85% for these with respect to the flora of the country.

**Vertical and horizontal structure**

Figure 4 shows that the greatest number of individuals are found in the herbaceous stratum with 348 (93 %), 28 (7 %) in the shrub stratum and 0 (0 %) in the tree stratum; this shows that the species of the shrub stratum have not completed their full development due to their recovery from the damage caused by a forest fire, which evidences the lack of vegetation in the tree stratum.

The most abundant species in the different strata are typical of this type of formations, where temperatures are high and rainfall is low, it can be observed that these species have small and thin leaves, deep and thorny roots.




Total number of individuals present in each of the strata.

Source: Self elaboration

This characteristic is corroborated by similar studies conducted by González et al. (2017), in pluvisilva forests in the eastern region of Cuba, where the shrub stratum fluctuates between 20 and 60 % density and the herbaceous stratum between 80 and 100 % of its density. **Determination of the index of ecological significance value.**

Table 1 shows the results of the species of greatest ecological importance: Bourreria divaricata, Maytenus elaeaodendroide, Malpighia cubensis and those of lesser ecological importance: Brya ebenus, Guaiacum officinarum, Euphorbia láctea.

The species with the highest indexes are considered important for future reforestation plans or reestablishment of this forest, since they are the indicators of the area and the ones that will best adapt to the edaphoclimatic conditions of the area, which guarantees a greater probability of their survival.

| **Species** | **Relative frequency** | **Relative dominance** | **Relative abundance** | **IVIE** |
|---|---|---|---|---|
| **Species with higher and lower results** | | | | |
| *Bourreria divaricata* | 100 | 17,34 | 15 | 132,34 |

| | | | | |
|---|---|---|---|---|
| *Maytenus elaeaodendroi* | 30 | 75,69 | 1 | 106,69 |
| *Malpighia cubensis* | 80 | 0 | 8,75 | 88,75 |
| *Sida glutinosa* Cav. | 60 | 0 | 6,25 | 66,25 |
| *Zygophylum fagora* | 60 | 0,18 | 5,75 | 65,93 |
| *Agave americano* | 50 | 0 | 7,75 | 57,75 |
| *Plumeria obtusa* | 40 | 3,75 | 1 | 44,75 |
| *Brya ebenus* | 30 | 0,68 | 2,5 | 33,18 |
| *Coccothrinax sp* | 20 | 1,34 | 2,75 | 24,09 |
| *Guaiacum officinales* | 10 | 0 | 0,5 | 10,5 |

Table 1. Evaluation of the Index of Ecological Importance Value.

Source: Self elaboration

Taking into account the Index of Ecological Importance Value (IVIE) at the species level, the vegetation was characterized, in a general sense heterogeneous, since the ecological weight of species with diameter greater than or equal to 5 cm, resulted with different values, reflecting that the species that present greater dominance are the least abundant and frequent, according to Taylor (2016), this occurs whenever the greatest ecological weight is favored by the species.

This research contributes to raise the knowledge of the main species found in this ecosystem in function of looking for alternatives to guarantee the recovery of the areas affected by forest fires, maintain an ecological balance and guarantee a sustainable development to improve the structure of the forest and the control of the affectations of invasive species that cause degradation. It is useful for students, local inhabitants and people interested in expanding their knowledge about the effects of forest fires on ecosystems and a better knowledge to conserve natural resources and in turn serve as training for the stable and sustainable management of the areas.

# Conclusions

Biodiversity is recovered in the ecosystem of ecologically important forest species in order to improve the structure and composition to ensure social, environmental and economic benefits. Species diversity in the area is low, which shows that these ecosystems are intolerant to the occurrence of forest fires. Among the species with the highest IVIE are Bourreria divaricata,

Maytenus elaeaodendroi, Malpighia cubensis and those of lesser ecological importance are Brya ebenus, Guaiacum officinarum and Euphorbia láctea.

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