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Diversidad florística en un ecosistema forestal del municipio El Salvador

Floristic diversity in a forest ecosystem of El Salvador municipality

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Resumen

La investigación se desarrolló en la Unidad Básica de Producción Cooperativa Alfonso Escalante, localidad de Costa Rica, municipio El Salvador, provincia Guantánamo, con el objetivo de evaluar la diversidad florística del ecosistema forestal. Se levantaron 10 parcelas de 20 x 25 m (500 m^2) de forma aleatoria, contabilizándose especies florísticas en los diferentes estratos: herbáceos, arbustivos y arbóreos; midiendo altura y diámetro, caracterizando la diversidad alfa y beta. Fueron identificadas 11 familias, 21 especies, 791 individuos. La familia de mayor riqueza fue Mimosaceae y 269 individuos, las especies de mayor índices de valor de importancia ecológica *Lisosoma latisiliquum.*

Palabras clave: Especies florísticas, Diversidad, Aleatoria, Estratos

Abstract

The research was carried out in the Alfonso Escalante Cooperative Basic Production Unit, Costa Rica, El Salvador municipality, Guantánamo province, with the objective of evaluating the floristic diversity of the forest ecosystem. Ten plots of 20 x 25 m (500 m2) were randomly surveyed, counting floristic species in the different strata: herbaceous, shrubs and trees; measuring height and diameter, characterizing the alpha and beta diversity. Eleven families, 21 species, 791 individuals were identified. The richest family was Mimosaceae and 269 individuals, the species with the highest indexes of ecological importance value Lisosoma latisiliquum.

Key words: Floristic species, Diversity, Random, Strata

Introduction

The natural environment provides the basic conditions under which humanity could not survive. Life on the planet is contained in the biosphere, in a thin, irregular envelope that surrounds the Earth's surface, just a few kilometers thick. In this layer, ecosystems purify the air and water that form the basis of life, stabilize and moderate the Earth's climate, renew soil fertility, recycle nutrients and plants carry out the process of photosynthesis, according to Jaula (2002).

For years, man has intervened in an irrational and uncontrolled manner on the natural resources of his environment, which is identified with the environmental problem of the man-nature relationship.

Humanity is going through an important and decisive moment in its development; never before have the planet's ecosystems been so affected by the presence of man. Large extensions of the world's forests, which have served for the sustenance, survival and progress of mankind, have been seriously exploited and degraded, where it is clear that natural resources are not infinite and that their judicious and sustainable use is necessary for survival, thus declares FAO (2002).

Vargas, et al. (2010), explain that ecosystem management through conservation and ecological restoration is gaining strength every day as a solution to reverse processes of ecosystem degradation and accelerated biodiversity loss. The relationship among conservation, biodiversity and ecological restoration is becoming more evident each day.

In the locality of Costa Rica, forest ecosystems are affected by the action of man, due to the application of fires and the indiscriminate cutting of trees, which affects the biodiversity of the different forest species typical of the area, it is necessary to look for alternatives in order to know the structure and composition to guarantee the social, environmental and economic benefits in order to conserve the water resource. Therefore, the objective is to evaluate the floristic diversity of the forest ecosystem in the Basic Unit of Cooperative Production (UBPC) Alfonso Escalante belonging to Costa Rica locality in the municipality of El Salvador, Guantánamo.

Development

The study area is located in the western part of Guantanamo province, in the Costa Rica Popular Council of El Salvador municipality, specifically in the Alfonso Escalante Villa UBPC, belonging to the Argeo Martínez Base Business Unit (UEB) of the Guantánamo Sugar Company, in the period from September 2019 to August 2020.

The UBPC Alfonso Escalante, limits to the North with the Realengo 18, to the South with Sierra Canasta, natural mountain space with an altitude between 500 and 2 380 m high and a rugged relief that provides a diversity of landscapes and environments, the soil is sialytic brown according to the characterization of the soils of Cuba given by Hernandez, et al. (2019); it presents a tropical savanna climate for being part of the island of Cuba and for being located in the tropical zone. The climate is under the action of the trade winds, which maintain an average annual speed of 7.2 km / h, according to CITMA (2020); it is bordered by the UBPC Lucrecio Cabrera and to the west by Los Reynaldo, a town belonging to the province of Santiago de Cuba.

100% of its agricultural areas are represented by the brown soil type with carbonates belonging to the Calcic Sialitized Grouping. The capillary elevation (EC) is evaluated as low (94 -30 mm/5h), in turn, the upper limit of plasticity (LSP) presents a behavior classified as plastic whose results range from 84.1 to 90.95%, while the air dry hygroscopicity (hy) is evaluated from low to medium.

The climatic characteristics between the years 2016-2019, according to data from CITMA (2020); explains that the average annual temperature is 25.5 oC., absolute maximum of 33.9 oC and average absolute maximum of 31 oC. The average minimum recorded is 17.1 oC. and as absolute minimum 20 oC., while rainfall is 1 212.6 mm per year, the wettest months are September and November; the coldest month is January, with an average of 17.1 °C and the hottest is August, with 33.9 °C. The climate is under the action of the trade winds that maintain an annual average speed of 7.2 km/h.

To carry out the study, 10 plots of 20 x 25 m (500 m2), randomly distributed in the area, were made, counting the species present in the different strata defined by Alvarez and Varona (2006): herbaceous (up to 0.99 m), shrub (1 to 4.99 m) and tree (greater than 5 m), also the species present in the shrub and tree strata were measured in height (h), determined by visual assessment and diameter (d) with a diametric tape.

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

Species diversity

Beta diversity (β), for this study a hierarchical cluster analysis was applied using the Sorensen distance measure according to the explanation of Beals (1984), and the linkage method was that of the average link between groups (Group Average Link), according to Bio Diversity Pro Version 2.

Diversity (alpha) was determined using the methodology of Aguirre (2015), where the richness index, proportional abundance of species, species dominance, index of ecological importance value and forest structure were determined.

Margalef's (1968) wealth index is calculated using the formula:

$$Dmg = \frac{S-1}{\ln N}$$

Where:

Dmg = Margalef's wealth index

S = number of species

N = total number of individuals

The proportional abundance of species is calculated by means of the $Pi = \frac{Ni}{N}$ formula :

Where:

= Probability of the species with respect to the set

= Number of individuals of the species

= Total number of individuals in the sample

Dominance

Simpson's index is determined by the following formula, according to Moreno (2001):

$$D = \frac{\sum(ni(ni-1))}{(N(N-1))} \quad R = \frac{1}{D}$$

Where:

= Number of individuals per species, = Total number of individuals and R= Richness.

Horizontal Structure

Horizontal structure parameters were determined through the calculation of: relative abundance (Ar), relative frequency (Fr), and relative dominance (Dr.) of each species, according to Moreno and Halffter (2001), according to the formula:

$$AR = \frac{\#\ de\ individuos\ de\ una\ especie}{Total\ de\ individuos\ de\ todas\ las\ especies} * 100$$

$$FR = \frac{\#\ de\ parcelas\ en\ la\ que\ ocurre\ una\ especie}{Total\ de\ ocurrencia\ en\ todas\ las\ parcelas} * 100$$

$$DR = \frac{Área\ basal\ de\ una\ especie}{Área\ basal\ de\ todas\ las\ especies} * 100$$

Index of ecological importance value (IVIE)

The index of ecological importance value of the species was evaluated, based on the methodology proposed by Keels, et al. (1997), which was obtained by adding the parameters of the horizontal structure, according to the formula:

The data were processed using the statistical program Bio Diversity Pro, to calculate the Biodiversity indexes (species richness, abundance and dominance indexes) and to perform cluster analysis.

Microsoft Excel was used to enter the data, prepare tables and graphs, and Microsoft Word was used to interpret the results obtained.

The behavior of the floristic inventory, when analyzing the area-species curve, had a representative sampling of the diversity of species in the area studied. From plot 7 onwards, the asymptote is achieved, which indicates that due to the characteristics of the area, it is very unlikely that new species will appear in environmental conditions with the same characteristics, so it can be stated that from the floristic point of view, the area reaches a balance in similar edaphoclimatic conditions.

Beta diversity (β)

The conglomerate analysis allowed us to distinguish three groupings according to the composition and abundance of woody flora species in each of the plots, showing a high degree of anthropization as shown in Figure 1.

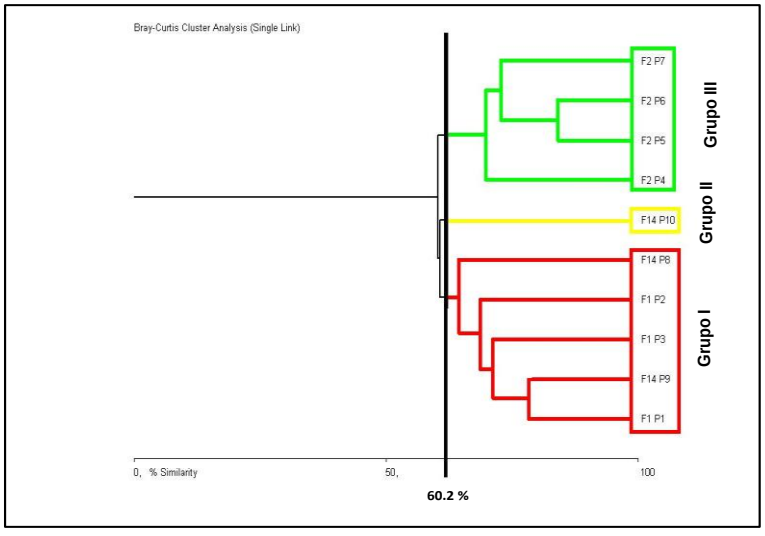

Figure: 1. Dendrogram by conglomerate analysis.

Source: Self made

Group I, consisting of five plots (1, 2, 3, 8, 9), is the richest in terms of number of genders and species with a total of 19 and 399 individuals, where the most representative species are Lysiloma latisiliquum

(L) Benth Urb. (Soplillo) (64), Leucaena leucocephala (Lam.) De Wit (Ipil- Ipil) (55), Tamarindus indica L. (Tamarind) (30) and Peltophorum linnaei (Mill.) León (Yarua) (15) showing no signs of disturbance in their population.

Group II, formed by one plot (10), is the poorest in terms of number of genera and species with a total of 17 and 106 individuals; with 60.5% similarity the most abundant species in terms of number of individuals that compose it are: Peltophorum linnaei (Mill.) Leon (Yarua) (16) followed by Lisosoma latisiliquum (L) Benth Urb. (Soplillo) (11), thus not being the case of Colubrina arborescens (Mill.) Sarg. (Bijaguara) (1), Psidiun guajaba L (Guava) (1) and Simarouba laveis DC. (Sparrowhawk) (2), which are affected by the few individuals that compose them.

Group III, formed by four plots (4, 5, 6, 7), the number of species is 17, while the total number of individuals is 286, plot 4 with 70% similarity, plot 5 with 60.2% similarity, plot 6 with 84% similarity and plot 7 with 70% similarity, standing out as the most representative species by the number of individuals Peltophorum linnaei (Mill.) León (Yarua) (98), Prosopis juliflora (Sw.) DC. (Prosopis) (32) and Lisosoma latisiliquum (L) Benth Urb. (Soplillo) (25).

Taking into account the location of the plots that make up these groups, and the characteristics of the study area, a high degree of anthropization is not evident, since the number of species is high, where species resistant to this type of forest formation can be found, due to their morphological characteristics, as these results coincide with those contributed by Acosta, et al. (2014), in the area of Baconao, Santiago de Cuba and in the coastal areas of the southern Sierra Maestra.

Alpha diversity (α)

A total of 11 families and 21 woody species were identified in the study, with 791 individuals as shown in Figure 2, where the most representative are: Mimosaceae with three species, and 269 individuals, being the species with the highest abundance: Lisosoma latisiliquum (L) Benth Urb. (Soplillo) (100), while the Caesalpiniaceae is represented by one family and species Peltophorum linnaei (Mill.) León (Yarua) (129), while the Meliaceae is represented by two families and two species, the species with the highest abundance is Azadirachta indica A, juss (Ni tree) (45), eight other families stand out with one species and a high number of individuals among them.

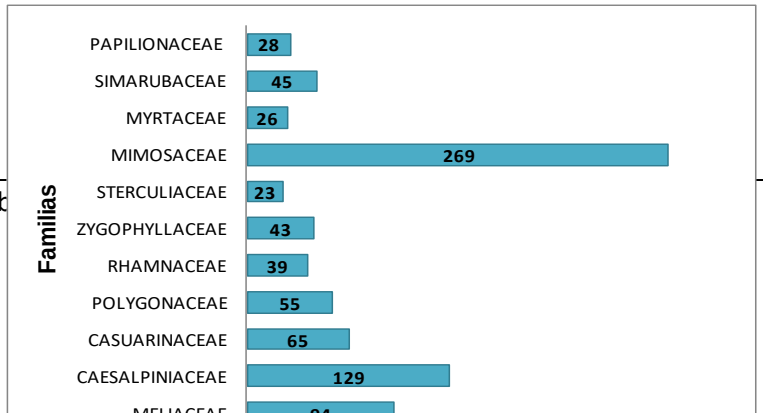

Figure: 2. Families with the highest number of individuals

Source: Self made

The biological diversity indexes made it possible to obtain complete parameters of species diversity in the habitat, quantifying the number of species and their representativeness.

The relative abundance is low, not reaching 50%, the six most abundant species within the plots are: Peltophorum linnaei (Mill.) Leon (Yarua) with 16.31% and 126 individuals, Lisosoma latisiliquum (L) Benth Urb. (Soplillo) with 12.64% and 100 individuals respectively, the most affected, from the point of view of the number of individuals present is Azadirachta indica A, juss (Ni Tree), with 1.26% and 10 individuals respectively.

The most dominant species are: Lisosoma latisiliquum (L) Benth Urb. (Soplillo), Colubrina arborescens (Mill.) Sarg. (Bijáguara), Peltophorum linnaei (Mill.) León (Yarua) among others, but these species are the ones that can reach the largest dimensions within the ecological reserve and that can guarantee natural regeneration, while the least dominant are: Azadirachta indica A, juss (Ni Tree), Simarouba laveis DC. (Sparrowhawk), Moringa oleifera Lam. (Moringa). Indicating that, although they are important in this type of formation, from the ecological point of view, they do not show large size, since this parameter of the horizontal structure (dominance) is directly proportional to the basal area that has a given species, indicating that there is affectation to the large individuals of these species.

The species with the best distribution in the area are: Lisosoma latisiliquum (L) Benth Urb. (Soplillo) with 6,667%, Guajacum officinale L. (Guaiacum), with 6,667%, Swietenia mahagoni L. Jacq. (West Indian Mahogany), with 6.66% and Peltophorum linnaei (Mill.) León (Yarua) with 6%, among others, and those with lower frequency, which have ecological importance in the ecosystem are Azadirachta indica A, juss (Ni tree) with 1.333%, Guazuma ulmifolia Lam (Guácima) with 1.333% and (Samanea saman (Algarrobo país) with 2.667%.

The species with lower values in terms of IVIE, Table 1, affected mainly by the parameters of the horizontal structure (AR, DR and FR), elements of importance for the recognition of this result, among the most affected are Azadirachta indica A, juss (Ni tree), Guazuma ulmifolia Lam (Guácima), in this case, the low presence of these species is due to the number of individuals when the design and planting were carried out and the deficient replacement of failures by the species planted according to the design.

Species of major (IVIE)	**%**	**Species of minor (IVIE)**	**%**
Lysiloma latisiliquum	51,66	*Azadirachta indica*	3,01
Peltophorum linnaei	31,01	*Guazuma tomentosa*	4,03
Colubrina arborescens	21,06	*Coccoloba diversifolia*	4,99

Table 1. Species with the highest and lowest Index of Ecological Importance Value (IVIE).

Source: Self made

These species of greater ecological importance allow them to be used in reforestation plans, given that they are the ones with the best behavior according to the edaphoclimatic conditions, with the objective of guaranteeing an ecological balance in the ecosystem and the conservation of the smaller ones should be continued to guarantee their continuity, in addition to guaranteeing the social, environmental and economic indicators.

These results are in correspondence with Taylor (2016), when explaining that the index of ecological importance value (IVIE), is characterized as a heterogeneous vegetation in a general sense, according to the ecological weight of the species with diameter greater than or equal to 5 cm, in addition to those of greater dominance, are the least abundant and frequent.

This research allows knowing the main species found in this ecosystem, in order to look for alternatives to guarantee the recovery of the areas in the short, medium and long term, maintain an ecological balance and guarantee a sustainable development that allows improving the structure of the forest and the control of the invasive species that cause degradation, allowing the students of the Agroforestry career a better knowledge to conserve the natural resources and to keep the population trained for their management in a stable way.

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. The richest families in the ecosystem are: mimosaceae and caesalpinaceae, which allow stability in the area in terms of sustainable development. The species with the highest index of ecological importance result are: Lisosoma latisiliquum, Peltophorum linnaei and Colubrina arborescens that guarantee the ecological balance according to the edaphoclimatic conditions of the ecosystem.

Bibliographic references

Acosta, C. R., Puchades, M. A. y Álvarez, Q, L. (2014). *Caracterización de los Bosques Semideciduos Mesófilo y Micrófilo el Refugio de Fauna El Macío, Granma Cuba*. Santiago de Cuba: Centro de Información y Gestión Tecnológica de Santiago de Cuba.

Aguirre, O. (2015). Manejo forestal en el siglo XXI. *Revista Madera y bosques*, 21 (SPE). pp. 17-28.

Álvarez, P. A. y Varona, J. C. (2006). *Silvicultura*. La Habana: Félix Varela.

Beals, W. (1984). *Bray-Curtis ordination: an effective strategy for analysis of multivariate ecological data.* Advances in Ecological Research 14, pp. 1- 55.

Carmona, H. (2001). *Conceptualización de cuencas*. Revista FAO. Series zonas áridas y semiáridas (4):17-39 p.

CITMA (2020). *Centro Meteorológico Provincial*. Delegación provincial Guantánamo.

FAO (2002). *Evaluación de los recursos forestales*. Capitulo 2 Volumen de madera y biomasa leñosa, Informe principal. Ediciones FAO, Roma, Italia.

Hernández, A., Pérez, J. M., Bosch, D. y Castro, N. (2019). *Clasificación de los suelos de Cuba*: *énfasis en la versión de 2015*. Cultivos Tropicales, versión impresa. Vol.40 no.1 ISSN 0258-5936

Jaula, J. (2002). *Algunos problemas sociales de la protección del medio ambiente frente al reto del desarrollo sustentable*. Documento preparado para curso de posgrado. Universidad de Pinar del Río. Cuba.

Keels, S., Gentry, A. and Spinzi, L. (1997).*Using vegetation analysis to facilitate the selection of conservation sites in Eastern Paraguay*. (Biodiversity measuring and monitoring certification training, Volume 2.Washington: SI/MAB).

Margalef, R. (1968). *Perspectives in ecological theory*. The University of Chicago Press. Chicago. Londres.

Moreno, C. E. y Halffte, G. (2001). *Spatial and Temporal Analysis pf Alpha, Beta and Gamma Diversities of Bats in a Fragmented Landscape*. Biodiversity and Conservation.

Shannon, C. E. (1948). *The Mathematical theory of communication*. En Shannon & Weiner (Eds.). The mathematical theory of communication. Univ. Illinois Press. Urbana.

Taylor, A. (2016). *Estructura y composición de bosques en paisajes manejados de los altos de Chiapas*. (Tesis de Maestría). El Colegio de la Frontera Sur. San Cristóbal, Chis. México.

Vargas, O., Reyes, S. P., Gómez, P. A. y Díaz, J. E. (2010). *Guías Técnicas para la restauración Ecológica de Ecosistemas.* Grupo de restauración Ecológica (GREUNAL). Departamento de Biología. Facultad de Ciencias. Universidad Nacional de Colombia.