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EFFECT OF THE CHANGE OF USE OF SUELO ON THE DIVERSIDAD DEL SOTOBOSQUE DEL PARQUE NACIONAL LA MALINCHE

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Abstract: The Parque Nacional La Malinche is a space for the conservation of natural resources, it is important to evaluate the effect on the diversity of the undergrowth before activities of the change of soil uses. For it, different sites were selected, Forest, Agricultural and Sanitation, in each site three quadrants were randomly selected divided into sub-quadrants of 2m2. The alpha and beta diversity indices were calculated with the Jaccard index. In total, 34 families, 68 genera and 70 species were registered, the forest presents the greatest richness. The highest value obtained from the Shannon-Wienner index was Sanitation 2.12 while the Simpson index was 0.82. The efficiency level of sampling in Bosque was 77%, Agricultural 100% and Sanitation 88%. The Bosque and Agrícola sites share 13.15% of species while between Saneamiento and Bosque 26.67%, finally between Saneamiento and Agrícola share 17.65%. El Bosque has the greatest wealth of families, genera and species. The Agricultural site has fewer species, due to the drastic modification of the environment that promotes the development of species associated with disturbed areas. The land use change promotes the reduction of native species in the forests in La Malinche National Park.
Keywords: Ecology, environment, climate change, biodiversity and conservation.

INTRODUCTION

The La Malinche National Park is a space for the conservation of natural resources, in addition to providing various ecosystem services (Silva y Correa, 2009).

The Protected Natural Areas (ANP) are a public policy instrument to face the change and transformation of ecosystems, in addition to allowing the conservation of available resources (Sahagún-Sánchez., 2018). However, land use changes have affected the biological diversity of this forest, which is why it is important to assess this impact using vegetation indices. The objective of the present work is to analyze the effect of the change in land use on plant diversity.

MATERIALS AND METHODS

Different soils were selected for their change of use within the Parque Nacional La Malinche, they are found within the community of San Bartolomé Cuahuixmatlac, municipality of Santa Ana Chiautempan, Tlaxcala. Where there are two well-defined climatic periods: drought and rain. The climate is subhumid, the average annual temperature ranges between 10 and 16°C, the warmest months are between March and June; the average annual precipitation between 700 and 1000 mm, the wettest months are present between May and September (López-Domínguez, 2005). It corresponds to the order Regosol 24%, Fluvisol 13%, Lithosol located in the highest part of the volcano and on the sides of the ravines and Feozem 4%. (INEGI, 2009).

The selected soils were forest, agricultural and soil under sanitation, the sample was carried out in the rainy season, in the month of November 2021.

1) Wood floor, predominates: *Pinus montezumae* y *Lupinus elegans* HBK, it is located in the geographic coordinates 19°16'16.5" N and 98°05'51.6" W at 2810 msnm.

2) Agricultural soil, cultivated with maize monoculture, for more than 40 years located at the geographic coordinates 19°16'16.5" and 98°09'51.6" and at 2810 masl.

3) Suelo con saneamiento, at the moment of the sample without the presence of arbolado by a controlled splint, due to the attack of the plague of the uncutting maggot that has affected thousands of trees inside the Parque Nacional La Malinche. It is located

at coordinates 19°16'56" N and 98°07'25" at 2592 masl. The sanitation was carried out in the month of October 2020 NOM-019-SEMARNAT-2017 which establishes the technical guidelines for the prevention, combat and control of gnawing maggots.

The sampling of vegetation in each plot was carried out using the quadrant method proposed by Mostacedo and Fredericksen (2000). From the quadrants brought to the soil sample, 3 of them were randomly selected and in their interior, quadratos of 2 m x 2 m = 4m2 were brought. Then the content of the herbaceous stratum was carried out at the species level to obtain the density and richness in each one of the quadrants.

The diversity indices were determined in each one of the soils, the alpha diversity indices were used to evaluate the diversity of the species present, within this diversity the Shannon-Weaver index (H') is calculated, which expresses the uniformity of the importance values across all species of the sample, on the other hand, the Simpson index that varies inversely with heterogeneity. For beta diversity, the Sorensen index was calculated, which is based on the presence and absence of the species of the compared communities.

RESULTS

In the forest floor we can observe a very particular case due to the fact that the family of the Oxalidaceae presents an abundance of 76.53%, which is highly representative of this site, while in the agricultural soil the families that are in greater proportion are Asteraceae and Poaceae with a 22.57% and 22.29% respectively, finally the soil with sanitation of the Rubiaceae with a 37.01, Poaceae with a 32.07% and Fabaceae with a 19.57% are the most representative. The Rubiaceae, Asteraceae and Poaceae families are the ones that are observed in each of the sites.

Family	Use of suel		
	forest (abundance %)	Agricultural (abundance %)	Sanitation (abundance %)
Rubiaceae	1	46.29	37.01
Asteraceae	2.3	22.57	6.91
Commeli-naceae	6.78	0	0.99
Poaceae	0.65	22.29	32.07
Fabaceae	3.89	0	19.57
Oxalidaceae	76.53	0	0
Brassicaceae	0	5.71	1.64
Geraniaceae	4.36	0	0
Others	4.49	3.14	1.81

Table 1. List of vegetation by family of the different soils within La Malinche National Park.

In Table 2 it is observed that there is a greater number of individuals in the forest, being able to find 1696 of which belong to 30 different species, the agricultural site only shows 350 individuals, meaning 13 species to which they represent.

The uses of ground forest and sanitation share a greater number of species, with respect to agriculture. According to Cadena et al. (2020), after a fire there is a greater abundance of shrubs, pastures and herbs, which is what happened in the soil with sanitation.

The indices of vegetation in the agricultural site show an important decrease with respect to the number of individuals and the number of species that affects the diversity of plant species in the Parque Nacional La Malinche, due to the change in soil use, confirming what it mentions Müller et al (2014) where he mentions that an important number of agricultural producers contribute to the loss of forests, which in the majority are for self-consumption and not leading to be redutable.

Site	Diversidad alfa			
	total number of individuals (n)	total number of species	Shannon	Simpson
Bosque	1696	30	1.093	0.4057
Agricultural	350	13	1.603	0.7111
Sanitation	608	27	2.122	0.8219

Table 2. Data on the vegetation indices of the different soils within La Malinche National Park.

For the Sorensen index, the forest and sanitation site shows a similarity of species of 42.11%, while in the agricultural and sanitation site the similarity is 30% and 23.26% between forest and agricultural.

Site	Sorensen index
Forest/Sanitation	42.11%
Agricultural/Sanitation	30.00%
Forest/Agricultural	23.26%

Table 3. Sorensen index for each of the sites within La Malinche National Park.

In the dendrogram we can observe the similarity in the plant diversity of each of the quadrants shown, observing that each site has representative species, in the forest there is a 13% similarity, in sanitation 17% and 21%. The quadrants that are most similar are A5 and A6 of the agricultural site.

Figure 2 shows the sampling efforts that were made in each of the sites, we can see that the greater the sampling effort, the number of species collected increases, at the beginning of the sampling the most common species of each were obtained. site and with the increase in collection, new species were incorporated into the list, such as species from other sites and unusual species.

The values obtained in the species accumulation curve show that 100% sampling efficiency was obtained for the agricultural site, which indicates that all the species present in this site were obtained, followed by 88% for sanitation. and 77% for the forest site.

Site	Sampling Efficiency Interval Level: %
Bosque	77
Agricultural	100
Sanitation	88

Table 4. Values of the species accumulation curve for each site.

DISCUSSION

In total, 34 families, 68 genera and 70 species were recorded, being the forest the one with the highest species richness. According to what was described by (López-Domínguez et al, 2004), 49% of families are reporting it.

In the agricultural site, 6 families were registered, belonging to 13 different species and 350 individuals, the families that were found with the highest number of species were Asteraceae and Poaceae specifically: *Richardia tricocca* y *Bidens odorata*.

According to Damascos (1997) the sets of species require a similar habitat, in the forests there is greater diversity, dominating in them the species with greater geographical amplitude. In the forest site, 15 families, 30 species, 1696 individuals were found, of the families registered, the ones with the highest abundance were Oxalidaceae (76.53%), Commelinaceae (6.78%) and Geraniaceae (4.36%), according to what was reported by (López- Dominguez et al, 2005) the families with the greatest number of species were Compositae, Gramineae, Leguminoseae, Caryophyllaceae and Rosaceae, on the other hand in this work they were Asteraceae, Poaceae, Fabaceae, Rosaceae, Scrophulariaceae, Solanaceae.

In the site under sanitation, 7 families were found, 27 species and 608 individuals, of which the families with the greatest abundance were Rubiaceae, Poaceae and

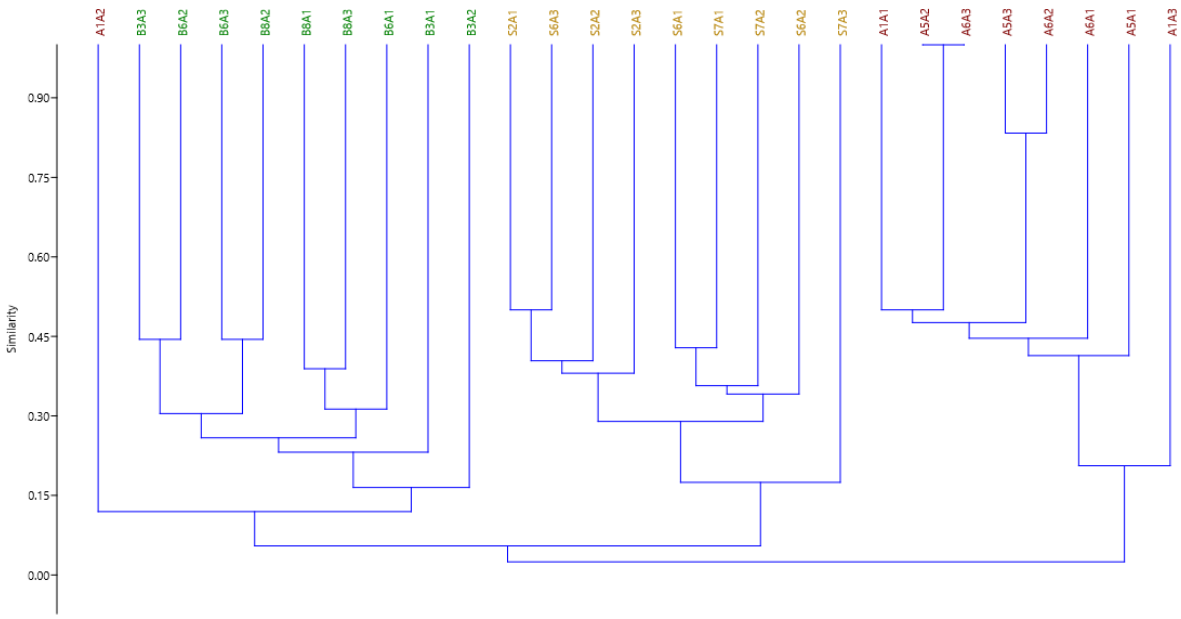

Figure 1. Dendrogram of the similarity of each of the quadrats sampled for the analysis of plant diversity.

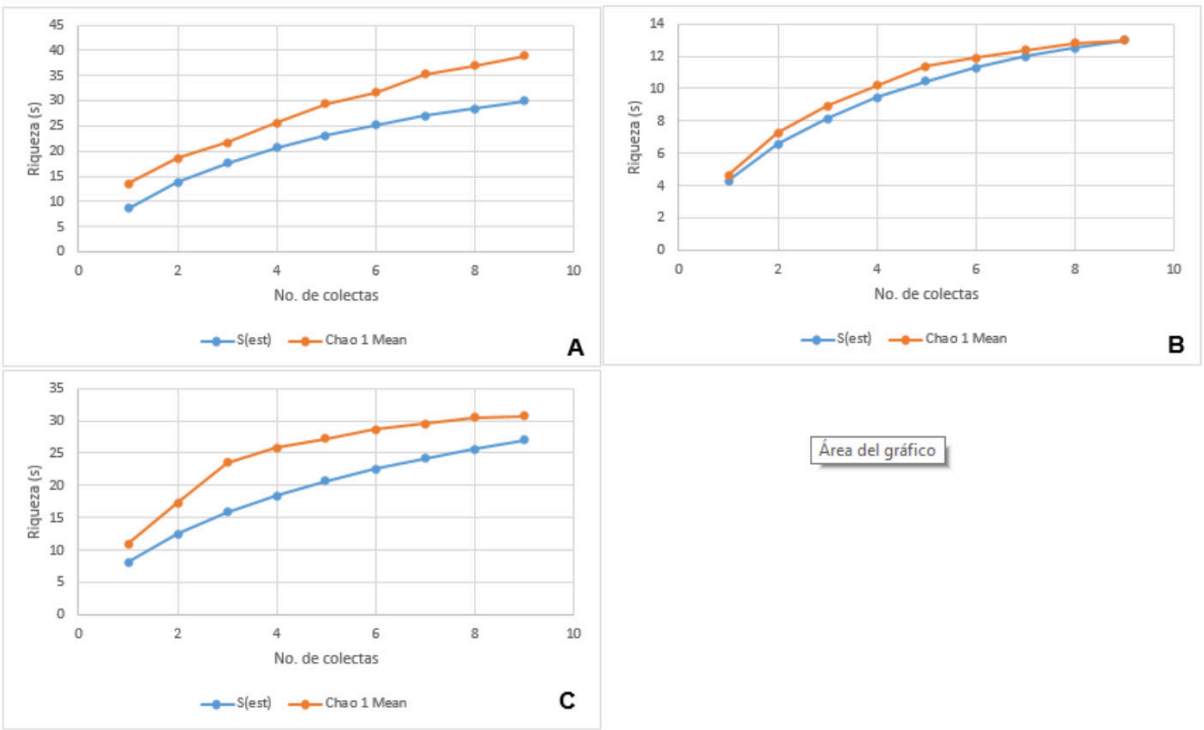

Figure 2. Species accumulation curve (sampling effort) of the site A) forest B) agricultural and C) sanitation.

Fabaceae, of the most representative species we found Piptochaetium virescens, Borreria laevis, and Desmodium uncinulatum. Despite the loss implied by fire, Granados-Sánchez et al (2007) mention that high temperatures are not capable of killing many of the roots and seeds of the disturbed site, producing a selection of plant species that favors some possessors. of particular adaptations. The communities maintained with the help of fire are quite stable, however, the misuse of this powerful instrument can often open the doors to accelerated erosion.

The Forest presents a greater wealth of families, genera and species; however, the abundance is not very high, which is reflected in the low values of the Shannon-Wienner and Simpson indices. The highest value obtained from the Shannon-Wienner index is for Sanitation with 2.12 and also for the Simpson index with 0.82. According to Rendón-Peréz et al (2012), the Simpson index found in the herbaceous stratum of the area under timber harvesting is 0.62.

From the richness, the level of sampling efficiency in the Forest was estimated to be 77%, Agricultural 100% and Sanitation 88%. In the agricultural site the curve is pronounced and manages to reach the asymptote, which means that it reaches the asymptote,

The Forest and Agricultural sites share 13.15% of species while between Sanitation and Forest they share 26.67%, finally between Sanitation and Agricultural they share 17.65%.

Forest and Sanitation share more species than these two with Agriculture, due to the drastic modification of the environment that promotes the development of species associated with disturbed areas. According to Jaksic and Fariña (2015) the plant species present in a site respond differently to a fire depending on their abilities to tolerate it and regeneration mechanisms. The fire had an important effect on the floristic composition, the structure and the functioning of the forests.

The change in land use promotes the reduction of native species in the forests in La Malinche National Park.

CONCLUSION

The forest floor presented greater richness of families, genera and species, but did not have an increase in abundances, according to the Shannon and Simpson index. This type of use with sanitation share more species than with agriculture, due to the seed bank within the forest, agricultural soil influences the selection of plants that are promoted with weeding activities. The change in land use promotes the reduction of native species within La Malinche National Park, and with it a modification to this type of ecosystem

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