Impacts of agricultural activities in remaining forest: Campinas/SP, Brazil

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Abstract

Forest fragmentation occurs normally in an area around the city or with high agricultural influence, such as the Forest of Quilombo that lies in Metropolitan Campinas/SP- Brazil. This forest is one such example since it is separated from the other forest fragments in the region for several types of human action. The objective of this study is to analyze the macro and micronutrients and soil edaphic insect fauna in the forest, pasture and sugar cane and inferring the impacts caused by the Mata do Quilombo cattle farming and urban expansion in chemical aspects of soil. Samples were collected in June/11, according to the procedure of method traps pitfall traps. In addition, at each sampling point four composite samples were collected for soil fertility analysis. Samples were collected at six points: pasture, degraded forest (near pasture), preserved forest (near pasture), degraded forest (near cane sugar), preserved forest (near cane sugar), and sugar cane sugar. The samples thus prepared were analyzed Ca, P, K, Mg, pH, organic matter, H + Al, Sum of Base (SB), Base Percentage Saturation (V%), Cation Exchange Capacity (CEC) and trace elements (S, B, Cu, Fe, Mg and Zn). Generally it can be seen that the group of organisms of soil fauna presented with little biodiversity. The number of individuals also shows little species, taxonomic groups showing the highest degree of impact that the remaining forest has suffered. Regarding the analysis of fertility it can be observed that the soil of the surrounding areas of the forest is under direct influence of agriculture.

Keywords: remaining urban forest, soil fertility, agricultural impact.

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1 Introduction

Knowledge of remnant native vegetation of a region and its relationship with the soil that supports it can assist in the maintenance and use of biodiversity of these ecosystems, a great challenge for science today the preservation of natural environments, which are under pressure anthropogenic that result in fragmentation and modification [1].

The most common reasons why man does deforestation are to salvage timber and to make way for the development of agricultural activities that permit the production of food to support a growing human population [2]. The fragmentation of vegetation exists simply because it is necessary to survival of man himself, then for that degrades the forest for expanding food production leading to soil depletion. Because Brazil shows a wide variety of terrestrial biomes, each with unique characteristics, many of the populations and their attributes are also, correspondingly, limited according to each macro-region. Furthermore, within the biomes, there are a variety of ecoregions, many with very specific ecological processes [1].

The Brazilian continental biomes are: Amazon, Cerrado, Atlantic Forest, Caatinga, Pantanal and Pampas. Among these, the most important are the Amazon, Cerrado and Atlantic Forest, opposite the land mass occupying and biological diversity they have. The limited knowledge about the diversity of the same, together with movements of degradation imposes the need for an investigation of the main species, either in natural conditions or in degraded areas, with all its consequences, or even from different tillage systems [3]. The analysis of biological diversity in degraded areas also becomes important therefore to understand and estimate the recovery of the same, there must be adequate understandings of environmental conditions present before, during and after a certain impact [3].

Besides its intrinsic value as a member of biological diversity, soil fauna enables observation of each individual without the need of special support resources. Another favorable condition is that the collection methods employed in the field are relatively simple, although it may introduce some restrictions or limitations [3].

Despite the existence of sustainable forestry and agricultural techniques, capable of increasing the productivity of land without incorporation of new areas, the agricultural frontier continues to advance, contributing to loss of biodiversity, loss of fertility, organic matter and soil microorganisms, and compacting [2]. In some areas of degraded is no longer a soil itself, but a little mineral material with organic material and very small amounts of plant nutrients, then reinstated to cover thus, starts a process through the soil formation Chemical changes along with the physical and biological properties.

The goal of this work is to perform analysis of macronutrients and soil macrofauna in the forest, pasture and sugar cane and inferring about the impacts on a forest cattle farming and urban expansion in chemical aspects of soil.

2 Methodology

The Forest of Quilombo, characterized by “cerrado” vegetation found, located in the Village of Florida north of Barão Geraldo, in the northwestern portion of the city of Campinas/SP, Brazil.

A preliminary characterization of the study area was carried out through work directly in the field where it has been the identification of native forest areas with spontaneous vegetation, pasture and sugar cane, opting to assess the interference of pasture and cane sugar remnant forest, having as main parameter analysis of soil fertility and soil macrofauna. In all areas aiming to identify the analyzed parameters can serve as indicators of biological and chemical degradation in urban forest remnants. The local soil is classified Oxisols purple [4].

Soil samples were taken in 06 points established in the preliminary survey of the area: P1: Preserved forest (near pasture area); P2: Degraded Forest (near pasture area); P3. Pasture; P4: Mata preserved (near the sugarcane area); P5: Degraded Forest (near the sugarcane area) – P6: Cane sugar.

The arrangement of the sampling points is shown in Figure 1.

Figure 1: Points where the collections of soil were made. (Source: Bing Maps Aerial 2010, without real value mapping, edited by REIS, MS.)

At each sampling point, four composite samples were collected at a depth of 0–20 cm. The samples thus prepared were analyzed Ca, P, K, Mg, pH, organic matter, H + Al, Sum of Base (SB), Percent Base Saturation (% V), Cation Exchange capacity (CEC) Micronutrients and (S, B, Cu, Fe, Mn and Zn). The samples for analyzes were performed entomafuna soil in the month of June/11 according to the procedure of the method of traps “pitfall trap” In locations with containers were placed 0.2 m high and 0.1 m diameter, containing approximately 0.45 l of 4% formalin and buried in trenches in the dimensions of the container so that the opening was on the level surface soil [3], as shown in Figure 2(a) and (b).

Figure 2: Pitfalls of the "pitfall traps." (a) System is ready for operation with the presence of litter around the opening of the trap, (b) positioning the container opening in the surface of the soil trap the remaining forests. (Source: Zangirolami, GF, 2010.)

The insects were as follows: as if locomoted litter found on opening the trap accidentally fell into the container and thus were prevented from fleeing by formaldehyde, which also kept them. The traps were kept in the field for seven consecutive days. After being closed were removed and taken to the laboratory for identification and classification of taxonomic groups of individuals [5].

With the intention of restoring biological conditions and then propose appropriate recovery of remnant forest, analyzes were made of the distribution of animal groups. For each area were made calculations of diversity indices, including the Simpson index (D) and the Shannon-Wiener Index (H) as found in [3] and described below.

$$\text{Simpson index: } D = 1/\Sigma pi\text{-}m\ 2 \tag{1}$$

where: pi is the proportion of individuals in the animal group of individuals i t total sample

Knowing that:
i = Orthoptera
j = Hymenoptera
k = Isoptera
l = Araneae
m = Hemiptera

$$\text{Shannon-Wiener index: } H = -\sum_{i=1} pi \log 2pi \tag{2}$$

where: pi is the proportion of individuals in the animal group of individuals i t total sample

3 Results and discussion

Table 1 presents the attributes of the chemical soil samples collected in the Forest of Quilombo, Campinas/SP later discussed trying to observe the differences obtained between the sampled points (different levels of degradation

occurring in the forest) allowing to verify the importance of analyzes of fertility indicates as soil chemical degradation in forests near urban centers such as the Forest of Quilombo.

Table 1: Chemical parameters analyzed according to the type of land use (macronutrients).

Point	P	Organic Mater	pH	K	Mg	H+Al	SB	CEC	V
	$mg.dm^{-3}$	$mg.dm^{-3}$	$CaCl^2$	$mmol.dm^{-3}$					%
P1: Preserved forest (near pasture)	3,25a	29ab	3,8b	1,1a	1,8b	97,7a	6,1b	103,8a	6,0b
P2: Degraded Forest (near pasture)	3,5a	29,5ab	3,8b	1,4a	3,0b	92,2a	7,2b	99,9a	7,7b
P3. Pasture	2,5a	21,25b	3,9b	0,9[a]	2,0b	57,2bc	7,2b	64,5b	11,0b
P4: Mata preserved (near the sugarcane area)	2,25a	38,5a	4,1b	0,8a	2,7b	92,5a	11,8b	104,3a	10,7b
P5: Degraded Forest (near the sugarcane area)	2,0a	37,75a	4,2b	0,8a	3,5b	80,2ab	15,1b	95,3a	16,3b
P6: Cane sugar	1,75a	28,75ab	4,9a	12,0a	12,0a	41,0c	3,7a	76,8ab	45,0a
Coefficient of Variation (%)	30,28	18,62	4,85	34,7	37,5	16,3	14,4	14,4	26,7

Means followed by the same letter in each column do not differ by Tukey test ($P < 0.05$).

In general, one can observe that the values of phosphorus (P), total bases (SB) and base saturation (V%) showed no differences between the sampling sites in the areas of remnant forest edge who suffered influence different agricultural practices. The content of organic matter (OM) showed lower value pasture area and the highest values in the areas of forest.

The pH ($CaCl_2$), the potassium (K) and the magnesium (Mg) showed the highest values in area influence of cane sugar, which reflects the effects of fertilization and liming suffered by crop which directly influences the areas of remnant edge. Pasture that got dirty greater value, but its content indicates the acidity in the soil as well as in the forest interior (near the pasture) and the forest edge (near the pasture), this is due to possible correction as the setting for the implementation of some culture in pasture. According macronutrients, aluminum (Al + H) and in Table 2 we can see the contents of micronutrients in the areas studied.

Analyzing the contents of micronutrients S (sulfur), Cu (copper), Mn (manganese) and Zn (zinc) showed no significant differences between the edges studied. Since the levels of Fe (iron), had the lowest values in the edge area next planting cane sugar and the highest levels of B (boron) were also observed in this situation, in general it can be said that in these micronutrintes area is influenced by the cultivation of sugar cane. Mesofauna in relation to the ground, the IDs of the major taxonomic groups of soil fauna, are presented in Figures 3–8.

Table 2: Chemical parameters analyzed according to the type of land use (micronutrients).

Point	S	B	Cu	Fe	Mn	Zn
	mg.dm^{-3}					
P1: Preserved forest (near pasture)	16,7a	0,4b	2,0a	148,2ab	2,3a	1,4a
P2: Degraded Forest (near pasture)	20,5a	0,4b	2,2a	137,0ab	7,4a	1,5a
P3. Pasture	9,5a	0,2b	1,6a	119,0ab	4,8a	0,8a
P4: Mata preserved (near the sugarcane area)	8,2a	0,4b	1,2a	153,7a	4,9a	1,3a
P5: Degraded Forest (near the sugarcane area)	9,7a	0,4b	4,35a	157,5a	4,9a	1,6a
P6: Cane sugar	7,7a	1,0a	1,63a	73,0b	4,0a	1,5a
Coefficient of Variation (%)	31,5	31,0	22,9	27,3	34,7	30,5

Means followed by the same letter in each column do not differ by Tukey test (P <0.05).

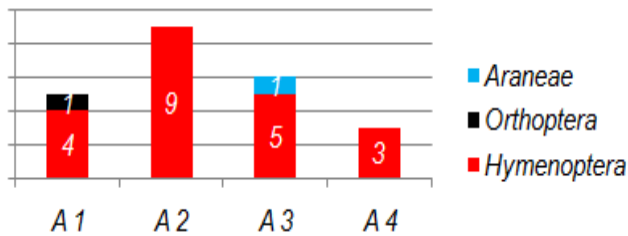

Figure 3: Soil mesofauna captured by the method “pitfall traps” – P1: Preserved forest (near pasture area) (where A1, A2, A3 and A4 are repeats of the same sampling areas).

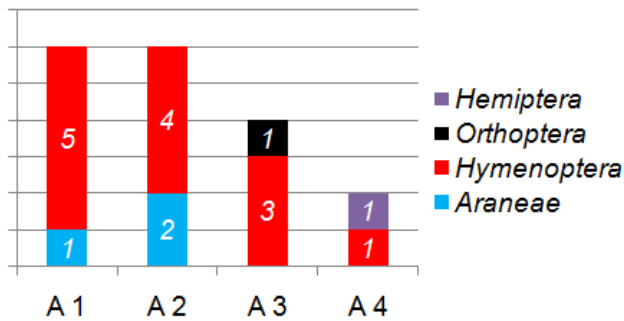

Figure 4: Soil mesofauna captured by the method “pitfall traps” – P2: Degraded Forest (near pasture area) (where A1, A2, A3 and A4 are repeats of the same sampling areas).

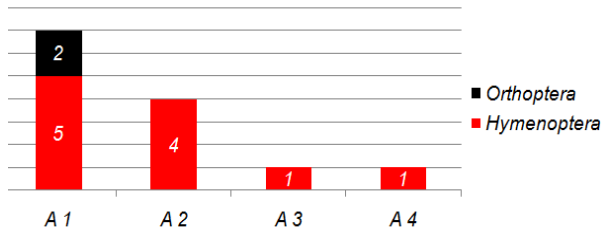

Figure 5: Soil mesofauna captured by the method "pitfall traps" – P3: Pasture (where A1, A2, A3 and A4 are repeats of the same sampling areas).

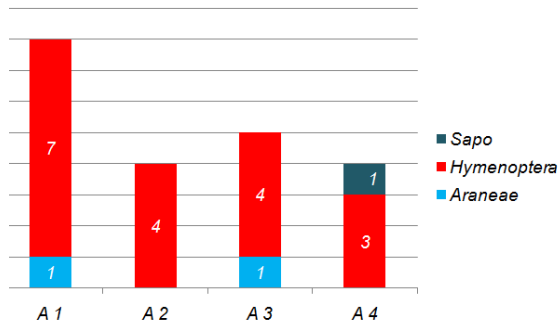

Figure 6: Soil mesofauna captured by the method "pitfall traps" in the pasture – P4: Mata preserved (near the sugarcane area) (where A1, A2, A3 and A4 are repeats of the same sampling areas).

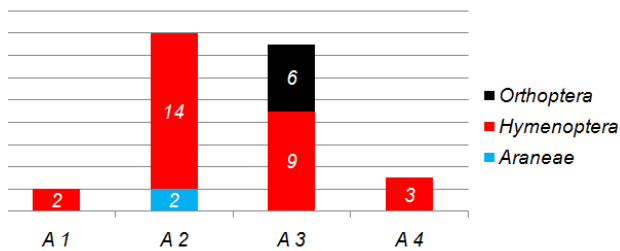

Figure 7: Soil mesofauna captured by the method "pitfall traps" – P5: degraded forest (near the sugarcane area) (where A1, A2, A3 and A4 are repeats of the same sampling areas).

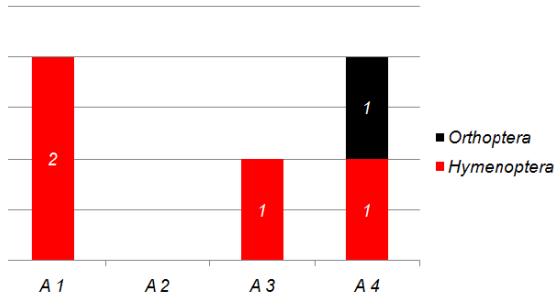

Figure 8: Soil mesofauna captured by the method "pitfall trap-s" – P6: Cane Sugar (where A1, A2, A3 and A4 are repeats the same sampling areas).

The diversity indices are calculated in Table 3.

Table 3: Simpson index (D) and Shannon-Wiener (H) in the sampled areas.

P1: Preserved forest (near pasture)		
Groups	**D**	**H**
Orthoptera	5	0,46
Hymenoptera	0,052	-47,23
Araneae	5,988	0,43
P2: Degraded Forest (near pasture)		
Groups	**D**	**H**
Orthoptera	4	0,5
Hymenoptera	0,104	-14,48
Araneae	1,2	2,8
Hemiptera	2	0,22
P3. Pasture		
Groups	**D**	**H**
Orthoptera	1,499	0,39
Hymenoptera	0,104	4,4
P4: Mata preserved (near the sugarcane area)		
Groups	**D**	**H**
Hymenoptera	0,064	32,02
Araneae	0,889	0,375
P5: Degraded Forest (near the sugarcane area)		
Groups	**D**	**H**
Orthoptera	0,417	- 3,03
Hymenoptera	0,044	- 64,19
Araneae	4	0,5
P6: Cane sugar		
Groups	**D**	**H**
Orthoptera	0,417	0,5
Hymenoptera	0,286	- 1,5

In general, one can observe a low biological activity at all sampling sites, thus demonstrating the high impact areas to the edge of the remnant has been suffering due to the strong influence of the surrounding agricultural area as well

as other types of human action. The macrofauna is presented in this way as a good indicator of degradation. However, due to the remaining studied is too degraded elsewhere, and that many of the indices are close to zero, the classifications were made considering the taxonomic group to which they belong and not invertebrates species.

4 Conclusion

The studied area is very run down, noticing the low levels of biological diversity found regarding macrofauna and is under direct influence of agricultural crops from surrounding areas which can be viewed by changes in soil chemical parameters in the sense most directly the next crop of sugar cane;

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