

Biodiversity of the macrofauna in a fragmented landscape and four land use from Santa Marta Los Tuxtlas, Veracruz, México

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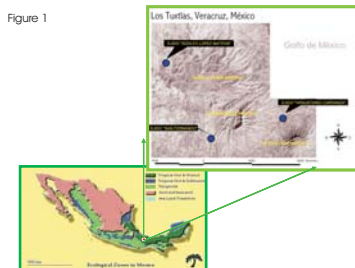
Introduction

The project Conservation and Sustainable Management of Below Ground Biodiversity (GEF, UNEP, TSBF-CIAT) were 6 country are participating.
 Has the **objective** to enhance awareness, knowledge and understanding of below ground biological diversity (BGBD) important to sustainable agricultural production in tropical landscapes by demonstration of methods for conservation and sustainable management. Has the **hypothesis** that by appropriate management of above- and below ground biota, optimal conservation of biodiversity for national and global benefits can be achieved in mosaics of land uses at differing intensities of management and furthermore result in simultaneous gains in sustainable agricultural production

In this frame an inventory of the soil macrofauna was carried out in the Biosphere Reserve Los Tuxtlas around the slopes of Santa Marta Volcano in Veracruz Mexico, in order to observe
 - the diversity of the macrofauna in the region
 - the impact of land use on the macrofauna
 - taxonomic units that could be used as an indicator of the soil quality and the intensity of land management.

Study Area

The study area is localized around the volcano Santa Marta in los Tuxtlas, Veracruz, México. Located near the Gulf of Mexico between 18°10' y 18°45' of north latitude and 94°42' y 95°27' of west longitude. Three sites were selected in: 1) "Adolfo López Mateos" (LM), 2) "Venustiano Carranza" (VC) and 3) "San Fernando" (SF) Community", figure 1.



Sites Description



Characteristic	Sites in Los Tuxtlas		
	Adolfo López Mateos	Venustiano Carranza	San Fernando
Annual precipitation	2000-2500mm	2900mm	1182.7mm
Altitude msnm	300	200	600-700
Types of soil	Humic Andosols	Gleyic Luvisols and Ochric Acrisols.	Ochric and Acrisols. Mollic Acrisols.
Original vegetation	High tropical rain forest	High tropical rain forest	Transition between rain forest, cloud rain forest.
% of remaining forest	75	25	50

INVENTORIES



Table 1. Sampling design

Four Land Use	Three Site	Sampling Point	Real Replica
A	LM	8	4
M	LM	8	3
P	LM	8	4
S	LM	8	3
A	SF	8	5
M	SF	8	5
P	SF	8	2
S	SF	8	1
A	VC	8	6
M	VC	8	4
P	VC	8	7
S	VC	8	5
All Groups			49

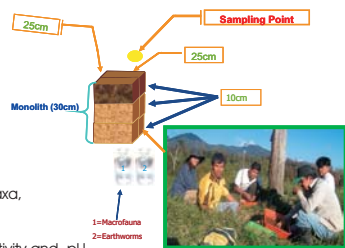
A: Agroforestry, M: Maize, P: Pasture, S: Forest

It is an unbalanced design. Real Replica is a mean of the sampling point within a same plot. Sample size varies between 1-8 per combination of treatments. (see table 1).

Macrofauna Sampling methodology

In each point one monolith was carefully manually revised. The earthworms were preserved in formaldehyde at 4% and the other organisms in alcohol at 70%.

Sampling Scheme for macrofauna



Variables:

Response variables:
 Taxa richness, density and biomass of the respective taxa.
Explanatory variables:
 Discontinuous: site and land use
 Continuous: soil bulk density, humidity, electric conductivity and pH

Data analysis

Analysis of Variance (ANOVAS) of taxa diversity (Richness, Shannon- Wiener (H'), Evenness (J), Simpson (D)). As it is not possible to consider replica with 0 individuals, the rule taken was that replica with 0 individuals will have a D=0.
 ANOVAS of most abundant taxa with land use type (4 levels) and site (3 levels) as treatments. For the macrofauna from the litter the taxa selected were with density > 4 ind m⁻² and biomass > 0.3 g m⁻² from the soil were with density > 4 ind m⁻² and biomass > 0.3 g m⁻².
 Detrended Correspondence Analysis (DCA) of community data (only taxa biomass in litter presented)
 Correlations of most abundant taxa and soil physicochemical parameters
 Made with Statistica, Canoco and Mini Tab

Most Relevant Results

- There is no differences between the land uses.
- The sites are not different in community composition (see DCA) but in richness ($F_{(2,43)} = 4.52 P = 0.02$) and diversity ($H' , F_{(2,43)} = 5.41 P = 0.008$; $D , F_{(2,43)} = 3.69 P = 0.03$) they are.
- The VC site is less diverse in macrofauna than the other 2 sites
- Richness is correlated with environmental parameters (bulk density and humidity)
- The DCA showed a grouping of the macrofauna community from the litter
- Diplopoda had presented significant differences ($F_{(2,43)} = 5.78 P = 0.006$) between the sites and significant correlations with soil bulk density.

Taxon	Litter Density (ind./m ²)		Biomass (g/m ²)		Soil Density (ind./m ²)		Biomass (g/m ²)	
	Mean	SD.	Mean	SD	Mean	SD	Mean	SD
Aranea	12.02	21.96	0.123	0.595	4.74	9.27	0.17	0.88
Blattelloidea	3.31	7.9	0.026	0.068	0.98	3.63	0.01	0.04
Chilopoda	1.64	4.29	0.006	0.025	20.44	35.04	0.42	2.21
Coleopt. Larv.	1.39	5.19	0.027	0.135	28.4	51.55	3.66	14.23
Coleoptera	15.91	46.09	0.049	0.129	11.15	18.47	0.46	2.27
Dermaptera	4.53	12.74	0.006	0.016	3.96	8.25	0.02	0.05
Diplopoda	1.7	5.65	0.016	0.061	15.99	27.1	0.48	1.83
Diptera	0.76	2.83	0.002	0.008	3.11	6.29	0.01	0.04
Diptera larv.	1.73	5.66	0.021	0.12	5.37	16.47	0.06	0.17
Formicidae	20.63	49.04	0.026	0.054	18.59	48.39	0.33	2.22
Gasteropoda	0.61	1.92	0.038	0.251	1.74	7.12	0.03	0.13
Hemiptera	0.83	2.9	0.002	0.008	0.96	3.77	<0.001	0.02
Hymenoptera	0.37	2.3	<0.001	0.002	0.49	2.32	0.01	0.06
Isopoda	4.53	14.39	0.018	0.062	3.22	12.27	0.63	4.44
Isoptera	0.27	1.36	0.004	0.025	40.54	124.77	0.35	2.22
Lepidopt. Larv.	2.33	6.1	0.194	0.819	1.76	5.94	0.29	1.66
Lepidoptera	0.33	1.6	<0.001	0.003	<0.001	<0.001	<0.001	<0.001
Mantodea	0.2	1.37	<0.001	<0.001	---	---	---	---
Oligochaeta	---	---	---	---	292.94	341.27	48.9	76.2
Opiliones	1.5	5.26	0.02	0.078	<0.001	<0.001	<0.001	<0.001
Orthoptera	0.86	4.69	0.013	0.069	0.65	2.16	0.21	1.14
Pseudoscorpionidae	<0.001	<0.001	<0.001	<0.001	0.35	1.58	<0.001	<0.001
Thysanoptera	0.09	0.65	<0.001	0.001	<0.001	<0.001	<0.001	<0.001

table 2. Mean and standard deviation of macrofauna density and biomass per taxon per real replica (n=49). All sites and land uses included.

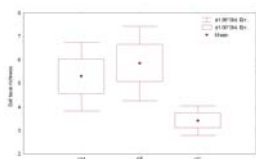


Figure 2. Taxa richness in the three different study sites: Lpez Mateos (LM), San Fernando (SF) and Venustiano Carranza (VC). Real replicates are considered (n=49)

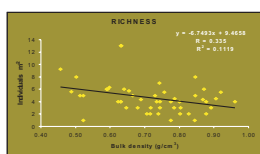


Figure 5. Species richness had presented significant correlation with bulk density.

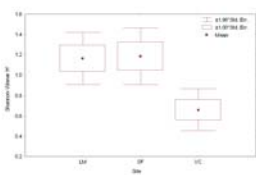


Figure 3. Shannon-Wiener index of diversity (H') in the three different study sites: Lpez Mateos (LM), San Fernando (SF) and Venustiano Carranza (VC). Real replicates are considered (n=49)



Figure 6. Ordination diagram based on detrended correspondence analysis of the community composition in Litter. Biomass per taxon per real replica are considered. Samples have been coded per land use type. Total inertia is 6.97. First two axes explain 22.5% of the overall taxa variance.

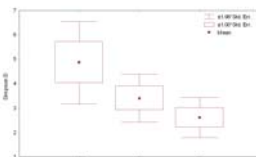
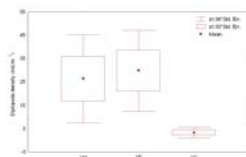


Figure 4. Simpsons index of diversity (D) in the three different study sites: Lpez Mateos (LM), San Fernando (SF) and Venustiano Carranza (VC). Real replicates are considered (n=49)



differences between the sites and significant correlations with soil bulk density, electric conductivity and humidity.

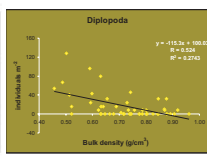


Figure 8. Diplopoda had presented significant correlation with bulk density.

Conclusions

As no differences were observed in the macrofauna community among the four land uses, a better discrimination of it could be done if:
 - the identification of the groups is made at lower taxonomic levels.
 - a supplementary sampling is done with more real replica per land use.

As the Diplopoda had shown significant differences with soil parameters it can be considered as a sensitive group or indicator of the land use and soil quality.

The DCA that showed the formation of groups need further exploration to know which are the variables that promote this grouping.

Perspectives

Recommendations in order to have a better discrimination of the macrofauna among the different land uses

The identification of the groups need to be more detailed
 More replica per land use and More correlation with physicochemical parameters.

Acknowledgements

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