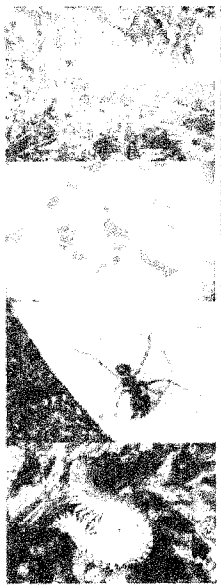

Within the frame of the project "Conservation and Sustainable Management of Below-Ground Biodiversity" funded by the GEF, supported by the United Nations Environmental Programme (UNEP) and executed by the TSBF-CIAT and the Instituto de Ecología A. C. with the participation of 45 persons (specialists and students) and 12 institutions, the present inventories of 8 groups of soil organisms were carried out in La sierra de Santa Marta in Los Tuxtlas, from microorganisms to macrofauna: the rhizobial bacteria, the root pathogenic (RPF) and arbuscular mycorrhizal (AMF) fungi, the nematodes, and the macrofauna (>2 mm > 2mm) globally and particularly the ants, beetles and earthworms. The chapters of this book present the detailed description of the benchmark site where the samples were collected and their socio-economic conditions, the methodologies used for field sampling and extraction of the organisms, the identification and taxo-nomic classification, the analysis of the abundance and diversity of the 8 groups.

En el marco del proyecto "Conservación y Manejo Sostenible de la Biodiversidad Bajo el Suelo" financiado por el GEF, implementado por el PNUMA, ejecutado por el TSBF-CIAT y el Instituto de Ecología A.C., con la participación de 45 personas (especialistas y estudiantes) y de 12 instituciones de México, se efectuó el inventario de 8 grupos de organismos del suelo en la sierra de Santa Marta, Los Tuxtlas, Veracruz, de organismos microscópicos como bacterias fijadoras de nitrógeno, hongos patógenos de raíz (HPR) y micorrizógenos arbusculares (HMA), nematodos, hasta la macrofauna (>2 mm), globalmente y particularmente las hormigas, escarabajos y lombrices de tierra. En los capítulos de este libro se describe detalladamente el sitio de [illegible] donde se colectaron las muestras, sus condiciones socioeconómicas, [illegible] utilizadas en el campo y en la extracción de los organismos, la identificación taxonómica y sistemática, [illegible] y diversidad de los 8 grupos.

GEF
BGBD
CIAT

Below-Ground Biodiversity in Sierra de Santa Marta, Los Tuxtlas, Veracruz, Mexico
Edited by: J. Barois, E.J. Hulsing, P. Okoth, D. Trejo M. De Los Santos

Below-Ground Biodiversity
in Sierra de Santa Marta,
Los Tuxtlas, Veracruz, Mexico

Project Conservation and Sustainable Management of Below-Ground Biodiversity
CSM-BGBD, Report Nr. 09-01

Edited by:
J. Barois, E.J. Hulsing
P. Okoth, D. Trejo
M. De Los Santos

Cover's design by Juan Arturo Piña Martínez
Book design by Liliana Calatayud Duhalt
Cover photographs (from right to left and from top to bottom):
Rain Forest: Isabelle Barois
Nitrogen-Fixing Nodules in bean: Esperanza Martínez and Marco A. Rogel
Atta mexicana: Patricia Rojas
Platydesmus sp.: Julián Bueno-Villegas
Enema pan: Miguel Angel Morón
Fusarium: M. McGinnis http: //www.doctorfungus.org/Thefungi/img/fussol.jpg
Diplopoda: Scott Justis http: //bugguide.net/node/view/267530/bgimage
Pontoscolex corethrurus: Luis Cunha

First edition 2009

ISBN: 798-607-7579-14-4

Printed in Mexico – Impreso en México

Title: Below-Ground Biodiversity in Sierra Santa Marta, Los Tuxtlas, Veracruz, México.
Subtitle: Project Conservation and Sustainable Management of Below-Ground Biodiversity CSM-BGBD Report Nr: 09-01.
Editors: Isabelle Barois, Elzo Jeroen Huising, Peter Okoth, Dora Trejo and Martín De Los Santos.
Suggested form for citing this book:
Barois, I., E. J. Huising, P. Okoth, D. Trejo and M. De Los Santos (Editors). 2009. Below-Ground Biodiversity in Sierra Santa Marta, Los Tuxtlas, Veracruz, México. 262p. Instituto de Ecología, A.C. Xalapa, Ver., México.

This publication presents part of the findings of the international project "Conservation and Sustainable Management of Below-Ground Biodiversity" implemented in seven tropical countries: Brazil, Côte d'Ivoire, India, Indonesia, Kenya, Mexico and Uganda. The project is coordinated by the Tropical Soil Biology and Fertility Institute of CIAT (TSBF-CIAT) with co-financing from the Global Environmental Facility (GEF), and implementation support from the United Nations Environment Programme (UNEP).

The views expresséd in various articles in this publication are those of their authors and do not necessarily reflect those of the authors' organizations, The United Nations Environment Programme or the Global Environment Facility.

The designation of geographical entities in this book, and the presentation of the material herein, do not imply the expression of any opinion whatsoever on the part of the publisher or the participating organizations concerning the legal status of any country, territorial area, or its authorities, or concerning the determination of its frontiers or boundaries.

Table of Contents

Report of the vascular flora characterization and α and β diversity index in three communities of Los Tuxtlas, Veracruz, Mexico

López-Cano, E.B.[1] and G.[1] Castillo-Campos.*
[1]Department of Biodiversity and Systematics. Instituto de Ecología A.C.: Km 2.5 Coatepec, Old Road No. 351, Congregación El Haya. Xalapa 91070, Veracruz, México. A.P. 63.
*Corresponding author: Tel.: +228-8-42-18-00 ext. 3106.
E-mail address gonzalo.castillo@inecol.edu.mx

Abstract

The overall goal of this study was to understand how vascular flora composition changes through different land use types in Los Tuxtlas, Veracruz, Mexico. We carried out quantitative flora sampling and created an inventory of the trees, shrubs, herbs and lianas species. To sample each land use type, we established 10 squares of 100 m^2. In total, we had forty of these 100 m^2 squares in every community in which we recorded the total number of species. The studied vegetation community had four well defined strata: (I) An arboreous stratum with a canopy that was 30 m tall, (II) The second stratum of medium sized trees and climber lianas that varied from 15 to 20 m tall, (III) The third stratum of shrubs with less than 8 m tall and (IV) The herbaceous stratum that was 0.5 to 3 m tall. The tropical rainforest present a high number of species, followed by acahuales (or secondary vegetation systems) with more than 5 years of abandonment. Pasture fields had the less number of species followed by maize fields. This study is incomplete; however, it gives an overview of the flora composition and beta-diversity between four different land use types in the study sites in Los Tuxtlas, Veracruz.

Key words: land use type, species diversity/density, vegetation strata.

Introduction

The original vegetation of "Los Tuxtlas" region is threatened by dramatic changes in land use. The deforestation in Veracruz maintains an annual rate of 4.3%. Also agriculture and stock breeding activities, industrial activities, secondary vegetation, human settlement and other anthropogenic systems occupy 74% of the surface, whereas the primary vegetation has been reduced to 23% of its original surface (CONABIO, 2002). Today, Los Tuxtlas' original vegetation fragments remain in the volcanic cones that exceed the 1,400 m altitude. The San Martín Tuxtla volcano, Santa Martha volcano and San Martín Pajapan volcano at 1,230 m altitude are the most important remnants of tropical forest in the region. Also, the primary vegetation fragments are immersed in grasslands and agricultural fields, which create a constant pressure to the conserved areas.

The present research aimed to measure the *alpha* and *beta* diversity in four different plant communities with different anthropization degrees. The overall goal was to understand the turnover species dynamic, generated by the different use types and land use intensification. It is important to know the land use types that destroy plant communities and the ones that promote the original vegetation, for propose new land use alternatives that ensure biodiversity conservation and the sustainable development of human activities.

The specific objectives of this study were to create:

(i) A vascular flora inventory of 4 different land uses types (pastures, corn fields, rainforest and *acahuales* or secondary vegetation systems) in three communities of Los Tuxtlas region;

(ii) A quantitative analysis of the structure and floristic composition of different *systems* and finally;

(iii) To determine the rate of species turnover between the vegetation communities with different land uses.

Methods

The method used in this study is the one proposed by Castillo-Campos (2003) for studying the low deciduous forest diversity in Central Veracruz. For the present investigation, this method present some modifications in order to meet the stated objectives.

Study area

The study areas and all sample points had been previously selected by the conservation and sustainable management of below-ground biodiversity (CSM-BGBD) project. A field visit was done to recognize the selected sites and for locate representative plots of each land use types.

Quantitative flora sampling consist in creating an inventory of trees, shrubs, herbs and lianas in 10 squares of 100 m^2 (10x10 m) per land use type in each community. Thus, in each community we had 40 squares to characterize vascular plants diversity. Inside of each 100 m^2 squares, we randomly established 3 small squares of 4 m^2 (2x2 m) in order to make the inventory of the herbaceous layer. For the 100 m^2 squares, we considered different environmental variables like slope, orientation, percentage of woody plant coverage, percentage of herbaceous coverage, percentage of bare soil, presence of stumps, percentage of rocky ground, perturbation factor and percentage of internal and external coverage. We also collected specific data from each plant sample: collector plant number, biological form (tree, shrub, herb or liana), height and abundance–coverage values with the scale proposed by Braun Blanquet modified by Maarel (1979). We collected the same type of data from the smaller (2x2 m) plots, except for environmental variables. Overall, we made 120 squares of 100 m^2 and 360 squares of 4 m^2 for the 3 selected communities.

This sampling structure ensured representativeness for the vascular flora in each selected land use type and determined the reliability of the statistical analysis.

Statistical analysis

Once the data matrix was ready, we recorded the specific richness i.e. total number of species for each land use type in each community. Then we obtained the Cody's (1993) Beta Diversity Index. We also did a cluster analysis with MVSP 3.1 computer program with the aim of differentiating the sampled vegetation types.

Vegetation Description

Based on the field visits and the samples that were collected, we have made a general description of the vegetation communities found in the four different land use types in Los Tuxtlas region.

Tropical rain forest. This vegetation community has four well defined strata. (I) An arboreous stratum with a canopy that was 30 m tall, composed principally by *Ocotea uxpanapana, Nectandra ambigens, Cynometra retusa, Ficus yoponensis, Brosimum alicastrum, Swietenia macrophylla, Pouteria sapota, Ceiba pentandra, Virola guatemalensis, Cordia megalantha, Terminalia amazonica* and *Spondias radlkoferi*. Those tall trees had straight and thick trunks, with well developed buttresses. The majority of the floristic elements are perennial. (II) The second stratum was formed with medium sized trees that varied from 15 to 20 m tall. The main species found were: *Cupania glabra, Dendropanax arboreus, Pseudolmedia oxyphyllaria, Guarea glabra, Dyospiros digyna,*

Digitaria (INECOL, 1999). The majority of grass fields were covered with introduced species like the "Pasto Estrella" from Africa (*Cynodon dactylon*), "Pasto Guinea" (*Panicum maximum*) and "Pasto Insurgente" (*Brachiaria decumbens*). The degradation of "grammas" and cultivated fields was caused by overgrazing and the incorrect use of herbicides. This process resulted in the domination of ruderal plants that were not consumed by cattle.

Maize fields. After coffee, maize (*Zea mays*) was the most important crop in terms of the cultivated acreage in the zone. The maize used in the region is a native variety called by land owners "Maíz criollo". Generally, maize is cultivated for self-consumption associated with other crops like beans (*Phaseolus vulgaris*), jícama (*Pachyrhizus angulatus*), pumpkin (*Cucurbita* sp.) and yuca (*Manihot esculenta*). We found some individuals of *Schizolobium pruriens* or "pica pica" in some maize fields, because this specie was used by some landowners like green manures, weed and erosion control. However, its cultivation has been abandoned. Each year, land owners had 2 sowing seasons: a temporal one in May and the winter or "tapachol" in October-November.

Preliminary results

A high richness was found in the tropical rainforest, followed by the acahuales (or secondary vegetation systems) with more that 5 years of abandonment. Maize and pasture fields were the least diverse in terms of species richness. In the tropical rain forest, we found in average 37 spp/100 m^2; in acahuales 31 spp/100 m^2; maize fields 26 spp/100 m^2, and finally in pastures we found 18 spp/100 m^2 (Figure 1).

The inventories show that pasture fields in San Fernando community had the highest species richness for this land use type. One reason that may explain this is the type of management by local farmers. Farmers within these communities allowed native species of grass to grow. These native grasses compete with introduced species like the "Pasto Estrella" (*Cynodon plectostachyus*) and "Pasto Insurgente" (*Brachiaria brizantha*).

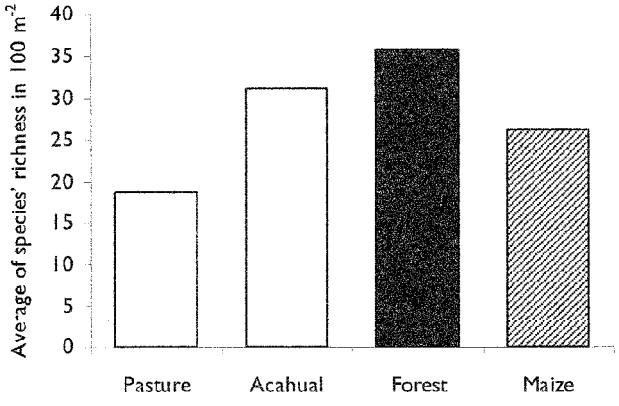

Figure 1. Species density per 100m^2 in each land use type in the three communities.

The rainforest fragments in Venustiano Carranza community had the highest species richness in the 100 m^2 squares. One likely explanation would be that the small rainforest patches acted as "islands" for different species that were part of a rainforest continuum. This may also be associated with the "edge effect" and the constant perturbation factors that may promote secondary vegetation or the growth of tourist species inside the fragments. López Mateos rainforest community had the lowest species diversity in 100 m^2. This shows that rainforest fragments in this area were in a better state than the other 2 communities.

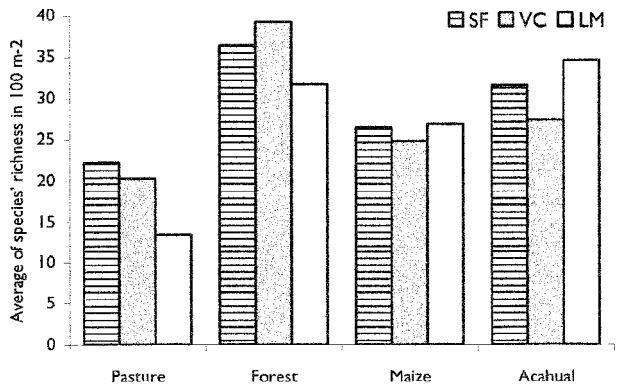

Figure 2. Average of species' richness in 100 m^2 in four land use types in the 3 sampled communities

Key: SF – San Fernando community; VC –Venustiano Carranza community; LM – López Mateos community.

The three communities present similar richness in 100 m^2 for maize fields. López Mateos present the highest number of species in acahuales. This may be caused by the incidence of rainforest seeds that arrive to the sampled sites. The acahuales closeness to the rainforest, environmental factors and the location of the sites (i.e. at the rainforest mountains bottom) allowed a higher number of species from the original vegetation, promoting a successful regeneration process. Figure 2 shows the richness of species in each land use type of each community.

Preview of current research

This investigation has the 60% of the work that was set to be done. Field work and the processing of material were complete. The inventory results included 940 botanic samples that were collected in the field. 80 percent of the species where identified, while the rest were still unidenitified. The data matrix was about 30 complete. In spite of the fact that this study is incomplete, it gives a large extent of what consists of the vascular species diversity in the four different land use types in the study sites in Los Tuxtlas, Veracruz.

References

CONABIO 2002. *Sierra de Los Tuxtlas-Laguna del Ostión. RTP-131.* May 2005. <http://www.conabio.gob.mx/conocimiento/regionalizacion/doctos/rtp_131.pdf>, (Accessed in May 2005).

Castillo-Campos, G. *Biodiversidad de la selva baja caducifolia en un sustrato rocoso de origen volcánico en el centro del estado de Veracruz.* Tesis doctoral. México D.F.: Universidad Autónoma Metropolitana, 2003, 9-20 pp.

Cody, M.L. 1993. "Bird diversity components within and between habitats in Australia". *Species diversity in ecological communities: historical and geographical perspectives.* Eds. Rickleff, R.E. and Schluter, Y.D. Chicago: The University of Chicago Press, 147-169 pp.

Instituto de Ecología (INECOL). 1999. "Evaluación de la importancia biológica global, las amenazas y causas subyacentes. Sierra de Los Tuxtlas". *Conservación de la diversidad biológica y desarrollo sustentable en áreas prioritarias de México.* GEF-PNUD-SEMARNAP. Informe final, 17-21 pp.

Maarel, V. 1979. *Biodiversidad de la selva baja caducifolia en un sustrato rocoso de origen volcánico en el centro del estado de Veracruz.* In: G. Castillo-Campos, 2003. Tesis doctoral. México, D.F.: Universidad Autónoma Metropolitana, 9-20 pp.