

DARWIN INITIATIVE FOR THE SURVIVAL  
OF SPECIES



**Biodiversity, conservation and  
sustainable use in a Mexican cloud  
forest**

THIRD REPORT

Rafael F. del Castillo  
Instituto Politécnico Nacional  
México

Adrian Newton

# **Biodiversity, conservation and sustentable use in a Mexican cloud forest**

## **Third Report**

This report contains a brief description of the main achievements of the project *Biodiversity, conservation and sustentable use in a Mexican cloud forest* up to April 2002

The major outputs of the project can be grouped in the following: thesis projects, manuscripts submitted or published, other kinds of dissemination, reports, biodiversity listings.

### **Thesis projects**

Darwin Initiative funding contributed to the design, execution and writing of six thesis projects, most of them concluded, Table 1). All of them consisted of a training period of at least one-year, including field and lab work, data analysis and writing. In addition to the trainees listed in Table 1, Janette Cordova, an undergraduate student, worked for us conducting a research which used epiphytes as bioindicators of the cloud forest. The results of such an investigation were already published (see papers and manuscripts). She received training for 18 months including sampling design, field work, plant identification, data analysis and writing, and, together with Elaine Marshall, formed a team conducting preliminary studies of forest resource use patterns involving an extra training period of three months.

## **Papers and manuscripts**

We have already five manuscripts finished. Two are already published. The rest were submitted (Table 2). In addition to that list, at least four scientific manuscripts are going to be derived from the project, for which we have already a significant advance:

(a) Demography of *Pinus chiapensis*; (b) changes in soil properties during secondary succession of a cloud forest; and (d) Multivariate relationships between diversity of soil macrofauna community and changing environmental conditions along a chronosequence of cloud forest.

Also, Darwin Initiative was important to start a series of studies for which an additional funding will be needed to complete. For example, our study of nitrogen mineralization *in vitro* was a good starting for a further study of the same process in the field. A study of plant-animal interactions related to seed and seedling dispersal and predation is part of a future project funded by the European Community. This study will complete the plant and fauna studies of the present project.

## **Dissemination**

Our results have been disseminated to three kinds of people: scientists, general non-scientist, and indigenous people in the communities in which the field work was conducted.

In addition to the papers described in the previous section, our results were presented in both national and international symposia, congresses and meetings (Table 3).

Our writing dissemination work included one newspaper article and one magazine article (**¡Error!No se encuentra el origen de la referencia.**). Our results were presented to the community of Juquila Vijanos and San Miguel Yotao in different ways: (a) a copy of our results was provided ([community\juquila.tif](#); [community\yotaodoc.jpg](#)); (b) a video was presented to the indigenous communities ([community\video\\_meso.WMV](#)); and (c) formal and informal talks with the members of the communities and authorities involved in permission for logging and forest management.

We are also working in a web page. Unfortunately our server is broken down, for the moment. But we will continue to work with this page as soon as our equipment is repaired.

### **Reports**

We are currently including the following individual reports: (a) changes of composition and structure of small mammals and in a cloud forest chronosequence. (b) *Pinus chiapensis* demography, (c) forest resource use patterns, (d) Potential timber species in the study area, (e) Biodiversity of El Gavilan Area, and (f) a summary of some properties of the ecosystem derived from our studies which can be used as bioindicators for monitoring the cloud forest (Table 5).

### **Biodiversity assessments**

The project made a significant contribution to biodiversity assessment of the cloud forest of the study area. In particular, the project contributed to the knowledge of soil microfauna through Negrete 's thesis, for which virtually nothing was known before. The thesis of

Blanco (2001) made a significant contribution to the flora of vascular plants in the area. The report of Briones et al. presents a list of small mammals. Finally, the article of Cordova and del Castillo (2001) provides a list of vascular plants and major groups of epiphytes. These studies not only contribute to the knowledge of the biodiversity of the area, but also studied how biodiversity changes through secondary succession. Except for the work of Briones et al., all of these studies included true replicates of seral states, something unusual in studies of succession. Finally, the study of the flora of El Gavilán area contributed to a list of 218 species of vascular plants. In addition to those studies, an electrophoretic survey of *Pinus chiapensis* contributed to the biodiversity knowledge at gene level of this timber species (Table 6).

### **Soil studies**

Darwin Initiative was instrumental in the developing of soil studies in the cloud forest for which virtually nothing was known before. A brief summary of them follows.

No study of soil classification was performed in the area and very few were performed in other cloud forest in the world. The study of Bautista et al (submitted) was the first to classify the soils of a Mexican cloud forest. This study revealed the presence of diagnostic horizons no previously reported for ultisols.

The thesis of Bautista revealed how soil properties change during secondary succession of the cloud forest using three chronosequences. This study is unique as we are not aware of any other study performed in cloud forest in the world which documented changes in soil properties during secondary succession with three independent replicates (chronosequences).

This study provides evidence that soil properties may change dramatically during secondary succession and, therefore, they potentially influence the species composition and structure. The thesis of Hernández Pérez, shows that indeed plants typical of different seral stages have different response in growth and resource allocation to soils from different seral stages. Thus, it is possible that changes in soil properties affect the course of secondary succession in cloud forest. The study of Velázquez shows that potential nitrogen mineralization change during secondary succession; and that ammonia is the dominant form of nitrogen in old seral stages, whereas nitrate is the dominant in early succession states. These results are important in the design of restoration plans as forest plants can be very selective to the form of nitrogen in soil. The thesis of Negrete not only provides evidence of the variation in composition of structure of soil macrofauna during secondary succession of the cloud forest, but also reveals how spatial patterns of these organisms change.

#### **Analysis of ecological impact of extraction of forest product**

This part of the project will be focused mainly in *Pinus chiapensis* for the following reasons: (a) this pine is the dominant species of young secondary forest surrounding the towns of El Rincón. (b) Because of (a) and the quality of its wood, this pine is the most important forest resource available. (c) this species is considered threatened. (d) we are not aware of any serious intent to preserve this species. We have collected demographic information for several years using permanent plots and will conduct a series of simulations to explore the impact of population structure of forest extraction, which will be included in the final report.

We did not pay much attention to *Magnolia dealbata* that was considered as a secondary important species for the following reasons:

(a) Our studies revealed that this species is not common in the woods and is already protected by the people of the communities. In particular, when a site is cleared for agriculture or for other reasons (e.g. trails, right-of-ways of electricity lines, roads, etc.) people do not cut down this plant. Commercially is not very important and it is used only during for limited time of the year during the spring when is blooming.

### **Developing of a management plan**

Our contributions in this area are the following: (a) a survey of biodiversity of the area is already available. (b) we have developed a series of bioindicators which can be used to monitor the forest. Indeed our first publication deals with the use of epiphytes for this purpose. Our results show that small mammals, plants, and soil properties can be used as bioindicators for cloud forest monitoring. (c) We provide a survey of the forest resource use patterns in the community of Juquila Vijanos. (d) a list of the major uses of *Pinus chiapensis* trough all its range is provided. Finally, we have in touch with the communities regarding the use and conservation of forest ecosystem. The final report will include a more detailed of such activities.

**Table 1.** Thesis projects funded by the Darwin Initiative for the Survival of Species through the project Biodiversity, conservation and sustentable use in a Mexican cloud forest.

<b>Thesis</b>	<b>Author</b>	<b>Status</b>	<b>File attached</b>
The multivariate relationship between the diversity of soil macrofauna community and changing environmental conditions along a chronosequence of Cloud Forest in Oaxaca, Mexico	Simoneta Negrete Y	In progress	<a href="#">thesis\repdarwin2.doc</a> (summary of advances)
Indicadores de la calidad del suelo en tres cronosecuencias de bosque mesófilo de montaña: Sierra Norte, Oaxaca.	BAUTISTA CRUZ, M.A.	Concluded*	<a href="#">thesis\tesisangelica.pdf</a>
Análisis sucesional en el bosque mesófilo de montaña en el Rincón, Sierra Norte de Oaxaca	BLANCO MACÍAS, A.	Concluded*	<a href="#">thesis\alex.pdf</a>
Influencia del suelo en el crecimiento de cuatro especies arbóreas a lo largo de un gradiente sucesional de un bosque mesófilo de montaña, Sierra Norte, Oaxaca.	HERNÁNDEZ PÉREZ, V.	Concluded*	<a href="#">thesis\tesisvero.pdf</a>
Mineralización del nitrógeno en suelos de bosque mesófilo en la región de El Rincón, Sierra Norte, Oaxaca	VELÁZQUEZ ARAGÓN, ALBERTO,	Concluded*	<a href="#">thesis\tssalber.pdf</a>
Estudio de la variación genética de <i>Pinus chiapensis</i> (Mart.) Andresen a través de métodos electroforéticos	GARCÍA CASAS, MARÍA DEL CARMEN.	Concluded*	<a href="#">thesis\tcarmen.pdf</a>

\* The full document will be included as part of the final report.



**Table 2.** Papers and manuscripts published or submitted derived from research totally or partially funded Darwin Initiative for the Survival of Species through the project Biodiversity, conservation and sustentable use in a Mexican cloud forest.

<b>Paper title</b>	<b>Author(s)</b>	<b>Type</b>	<b>Status</b>	<b>File attached</b>
En el país de las nubes	Del Castillo, R.F.	Magazine	Published	<a href="#">papers\NUBES.pdf</a>
Changes in epiphyte cover in three chronosequences in a tropical montane cloud forest in Mexico.	Cordova J, and R.F. del Castillo	Scientific	Published	<a href="#">papers/life forms.pdf</a>
Clasificación del Suelo de Bosques mesófilos Secundarios de diferentes edades, El Rincón, Sierra Norte-Oaxaca	A. Bautista Cruz, M. C. Gutiérrez Castorena, R. del Castillo and J. Etchevers Barra	Scientific	Submitted	<a href="#">papers/articulo.doc</a>
Ethnobotanical Notes on <i>Pinus strobus</i> var. <i>chiapensis</i>	del Castillo, R.F. and S. Acosta.	Scientific	Submitted	<a href="#">papers/ETHNO.DOC</a>
High population differentiation and low genetic diversity in <i>Pinus chiapensis</i> , a threatened Mexican pine, detected by RAPD and mitochondrial DNA markers	Newton, A. C., T. R. Allnutt, W. S. Dvorak, R. F. del Castillo, and R. A. Ennos.	Scientific	Submitted	<a href="#">papers/pinemolecular.doc</a>

**Table 3.** Proceedings and conferences related to the Darwin Project (C:\proceedings)

- Del Castillo, R. F., A. Bautista Cruz, A. Blanco Macías, M.A. Briones Salas, J. Cordova, Velázquez y R. Rivera. 2001. Bases ecológicas para un manejo sustentable del bosque mesófilo de montaña : bioindicadores y dinámica sucesional ante el disturbio I. VI Foro Estatal de Investigación Científica y Tecnológica. SIBEJ CONACyT. 10 – 11 Diciembre 2001. Instituto Tecnológico de Oaxaca Memoria pp. 77-78
- Del Castillo, R.F. A. Bautista Cruz, A Blanco Macías, M.A: Briones Salas, J. Córdoba Velázquez y R. Rivera. 2000, Bases ecológicas para un manejo sustentable del bosque mesófilo de montaña, bioindicadores y dinámica sucesional ante el disturbio. V Foro Estatal de Investigación Científica y Tecnológica, Memoria, 11-12 de diciembre 2000, Oaxaca.
- Trujillo, A.S. del Castillo, R.F., Newton, A.C. and Allnutt, T.R. 2000. Genetic diversity in the endangered pine *Pinus chiapensis*, British Ecological Society. 2000 special symposium. Plants stand still but their genes don't: integrating ecological and evolutionary process in a spatial context. Royal Holloway College, Egham, UK 21 – 31 August 2000. P. 26.
- del Castillo, R.F., S. Trujillo, N. Sánchez y R. Rivera. 1999. Comparing restricted vs. Widespread populations of the same species: studying the causes of extinction in *Pinus* . XVI International Botanical Congress Abstracts. St. Louis.U.S.A. 504.
- Bautista-Cruz, A., R.F. del Castillo, y R. Rivera. 1999. Changes in soil properties in three chronosequences in a montane cloud forest of Sierra Norte, Oaxaca, Mexico. XVI International Botanical Congress Abstracts. St. Louis.U.S.A. 523.
- Cordova, J., R.F. del Castillo. 1999. Epiphytes cover in diverse successional stages of a cloud forest in the Sierra Norte of Oaxaca. . XVI International Botanical Congress Abstracts. St. Louis.U.S.A. 550.
- Bautista Cruz, M.A. y R. F. del Castillo, R. Rivera 1999. Dinámica de los nutrientes del suelo en las diferentes etapas sucesionales de un bosque mesófilo de montaña. 29° Congreso Nacional de la Ciencia del Suelo. La Investigación Edafológica en México. Tapachula de Córdoba y Ordóñez, Chiapas. 27p.

**Table 4.** Reports from research totally or partially funded by the Darwin Initiative for the Survival of Species through the project Biodiversity, conservation and sustentable use in a Mexican cloud forest.

Author(s)	Title	File
Miguel Angel Briones Salas, José Antonio Santos, Ana Lilia Trujano.	Ecología de comunidades de pequeños mamíferos terrestres en tres cronosecuencias de bosque mesófilo de montaña en Oaxaca, México.	<a href="#">reports\fauna.doc</a>
Rafael F. del Castillo Salvador Acosta Castellanos Alejandra Blanco Macías Raúl Rivera García	Inventario florístico de El Gavilán	<a href="#">\reports\Inventario florístico de la zona de El Gavilán.doc</a>
R.F. del Castillo S. Trujillo	Estudio demográfico de <i>Pinus chiapensis</i>	<a href="#">\reports\Estudio demográfico de Pinus chiapensis.doc</a>
R.F. del Castillo	Usos Maderables Potenciales del Bosque Mesófilo de Montaña de El Rincón.	<a href="#">reports\timbersp.doc</a>
Elaine Marshall and Janette Córdova	Field study of forest resource use patterns in the community of Juquila Vijanos, in el rincón, in the sierra norte of Oaxaca, Mexico	<a href="#">reports\forestresources.doc</a>

**Table 5.** Reports, papers, manuscripts or thesis derived from which have contributions to the biodiversity of the study area.

<b>Report type</b>	<b>Title</b>	<b>Organism</b>
thesis	The multivariate relationship between the diversity of soil macrofauna community and changing environmental conditions along a chronosequence of Cloud Forest in Oaxaca, Mexico	soil macrofauna
report	Ecología de comunidades de pequeños mamíferos terrestres en tres cronosecuencias de bosque mesófilo de montaña en Oaxaca, México.	Small mammals
report	Inventario florístico de El Gavilán	Vascular plants
thesis	Análisis sucesional en el bosque mesófilo de montaña en el Rincón, Sierra Norte de Oaxaca	Vascular plants
paper	Changes in epiphyte cover in three chronosequences in a tropical montane cloud forest in Mexico.	Vascular plants/cryptogams
report	Inventario florístico de El Gavilán	Vascular plants
thesis	Estudio de la variación genética de <i>Pinus chiapensis</i> (Mart.) Andresen a través de métodos electroforéticos	Genetic variation of <i>Pinus chiapensis</i>