


Project Chicamocha II

Saving Threatned Dry Forest Biodiversity

Final report

Proyecto Chicamocha Colombia

Colombia
2008-2010

By
Jorge Parra,
Marcela Beltran,
Alexandra Delgadillo
& Sandra Valderrama

Fundación conserva

BirdLife International · Wildlife Conservation Society · bp · Conservation International · Fauna & Flora International

Conservation Leadership Programme

ProAves Colombia





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INTRODUCTION

By
Jorge Parra

The Chicamocha canyon is one of the largest and deepest canyons on earth covering 300.000 hectares in the East- Andes of Colombia. This region is home of a unique flora and fauna, with particular ecological and behavioural adaptations to face dry conditions. The landscape is characterized by a system of canyons, valleys and rivers. It is represented mainly by dry habitats with different species of cactus, spiny shrubs and trees. It is inhabited by several agricultural and commercial communities which have originated the Santander and Boyacá cultures. The Chicamocha canyon has been recently considerate one of the main touristic attractions in Colombia by its unique landscape, beautiful villages and several adventure sports. Thus, the region has all the potential to develop an environmental friendly economy. However, large natural areas have been destroyed and converted for agricultural practices. Hence, several habitats, species and water resources are endangered and started to disappear every day affecting ecological process and rural economies.

Two species of birds are of special concern in the Chicamocha canyon due to their endemism and to face imminent risk of extinction: the chestnut-bellied hummingbird (Amazilia castaneiventris) and the Niceforo's wren (Thryothorus nicefori). Since 2004, Project Chicamocha has been working in the conservation of these two species of birds, through tackle different drivers for conservation actions on their habitats. Our framework is based on our main goal: to recovery and protect populations of Niceforo's wren and Chestnut bellied hummingbird through smart environmental education programmes, network of protected areas and establishment a recovery programme of their natural habitats.

In this report, it is presented the creation of a natural reserve in one of the last pristine remnant of dry forest in the Chicamocha Canyon. After eight months of negotiation, in 2009, the first natural reserve in the area was established in the municipality of Zapatoca, when Fundacion ProAves, through its donors, acquired 3,211 acres (1,300 hectares) of land. Afterward this achievement, the project conducted studies on the mammals, insects, plants, amphibians, and reptiles present in the reserve. In addition, it is shown specific studies about the biology and ecology of the chestnut-bellied hummingbird and Niceforo's wren carried out by students and volunteers. Educational activities in rural schools, workshops, and media campaigns are presented as well. Finally, it is introduced "Fundación Conserva", established in 2009 by the members of the Chicamocha team, which continues working for the conservation of the two endangered birds and their habitats and to extend our experience to other threatened species and habitats. "Fundación Conserva" has begun working with a group of organizations through the Chicamocha Alliance, which aims to develop participative plans for the sustainable development of the Chicamocha canyon.

I want to thank all you, communities, students, organizations, researches, families and friends, who have helped in this project. You are contributing in the challenge for the conservation and development of the Chicamocha canyon.

TEAM MEMBERS

This project couldn't be a reality without the help and participation of our friends and collaborators. Bellow is the list of people that worked in the Project Chicamocha II:

- Jorge Parra
  Team leader
- Marcela Beltran
  Biodiversity inventorying coordinator.
- Alexandra Delgadillo
  Education and awareness campaign coordinator.
- Sandra Valderrama
  Chestnut-bellied Hummingbird and Niceforo´s Wren Monitoring Coordinator.
- Diana Guzman
  Graphic designer and environmental education collaborator
- Gerson Peñuela
  Amazilia castaneiventris researcher
- Ludy Archila
  Amazilia castaneiventris researcher
- Valentina Gómez
  Thryothorus nicefori researcher
- Antonio Quiñones
  Thryothorus nicefori researcher
- Alejandro Lozano
  Vegetation researcher
- Jessica Diaz
  Reforestation researcher
- Juan Salvador Mendoza
  Amphibian and reptiles researcher
- Manuel Rodríguez Rocha
  Bats researcher
- Elizabeth Bahamon
  Bats researcher

CHAPTER ONE

Proyecto Chicamocha Colombia

CONSERVATION IN THE CHICAMOCHA DRY FOREST, SANTANDER, COLOMBIA

By
Jorge Parra, Marcela Beltrán, Alexandra Delgadillo & Sandra Valderrama

BACKGROUND

The dry forest of the Chicamocha region has high levels of endemism at both species and subspecies level in birds, reptiles, and flora. This extraordinary ecosystem had not been protected. Unfortunately, very little vegetation remains in a natural state, with intense seasonal burning and grazing from goats and cattle. For example, the endemic and attractive Chicamocha Cavanillesia tree (Cavanillesia chicamochae) and Zamia encephalartoides are nationally Critically Endangered. After two years of searches across the region, the Niceforo´s Wren population was restricted on three small populations of less than 14 pairs. The principal subpopulation is located 10 km NE of the town of Zapatoca where 14 territories have been identified. Importantly, this population occurs in one of the last example of pristine dry forest in the entire region. The majority of the territories occur in two properties called Lagunetas and Cimarronera where Project Chicamocha has been working since 2004 with the owners.

For eight months Project Chicamocha team and ProAves Foundation were negotiating the property owner. Finally, the land owner and ProAves Foundation achieved an agreement to acquire the land and some of the land remains with the original owner who is one of our enormous collaborators in the study area.

Furthermore, Project Chicamocha achieved their main objective, acquiring the two properties of dry forest (1400 hectares), to put into practice the conservation strategy for the conservation of the Critically Endangered Niceforo´s Wren and Chestnut-bellied Hummingbird and a host of other threatened and endemic flora and fauna in the Chicamocha dry valley, in the Eastern Cordillera of Colombia.

WORLD LAND TRUST™

PROAVES COLOMBIA

1.1. CREATION OF THE NATURAL BIRD RESERVE "CUCARACHERO DEL CHICAMOCHA"

Figure 1.1. View of natural reserve Cucarachero Del Chicamocha.

In 2004 Project Chicamocha started a conservation project to save from edge of extinction two species of birds critically endangered:Niceforo's wren (Thryothorus nicefori) and Chestnut billed hummingbird (Amazilia castaneiventris). One of the objectives was found new records of individuals through the Chicamocha canyon because it was known just one location for each species. A. cataneiventris was rediscovered in Soata municipality in Boyaca region in 2003, where was the unique record at the time. T. nicefori was discovery in 1940's in San Gil municipality in the Santander region, which was the only location known for the species as well. Several explorations were conducted and new records and ecological data of both species were taken by the Chicamocha team.

In 2005, the Chicamocha team was invited by Dr. Milton Rueda, a paleontologist, to joint to one of his expedition to explore the area as possible habitat for both species of birds. The site was unique. It was found at least more than four individuals per species. The site called "Lagunetas" has one of the best preserved natural cover vegetation in the Chicamocha canyon, spite of the abundance of goat cattle. The site is in the municipality of Zapatoca – Santander where most of the people live from agriculture, and particularly of goat cattle in Lagunetas region.

Project Chicamocha started a series of biodiversity assessment expeditions in Lagunetas, specifically bird surveys. During the period of 2004 to 2006, all the information of the area was used to declare the dry forests of the Chicamocha valleys as important bird area (IBA, BirdLife International). It was also achieved a conservation awareness of the people of Lagunetas who started to recognize the value of the dry forest and services that it offers to them, especially water supply. The people from Lagunetas is conformed for just one big family, Acevedo family, who wanted to sell part of it huge land to different people in the region in small patches. They gentlemanly offered the land to Chicamocha team to maintain all the area preserved. Then, Project Chicamocha offered to find a conservation agency to create a natural reserve in the Zapatoca. Thus, it was possible a dream that Chicamocha team had the first time that the site was visited "create a natural reserve for the conservation of Niceforo's wren and Chest-nut billed hummingbird".

In 2007 Project Chicamocha dream was really when in a meeting with directors of Fundacion ProAves, in the Neotropical Ornithological Congress in Maturín - Venezuela, they decided to help buying the area to protect the habitat of both species of birds. Thus, it was created Project Chicamocha II, and it main objective was create: "Reserva Natural de Aves: Cucarachero del Chicamocha (Natural Bird Reserve: Chicamocha's wren)".

This report shows the establishment of the first natural area preserve in the Chicamocha canyon, where there was not any legal protection of its natural habitats. It was explored most of this area to assess the number of territories and individuals of Niceforo's wren and Chestnut bellied hummingbird as a main targets of conservation for funding to buy the land. Project Chicamocha also gave reports of the avifauna of the region and maps of the reserve. All the information supported that this natural reserve is a special concern for the protection of the unique biodiversity of the Chicamocha Canyon, which is considered a laboratory of speciation duet to its unique conditions and its isolation in the Andes of Colombia. The reserve is possible thanks to the family Acevedo who wants that the biodiversity and their stories of the Chicamocha will be preserved for future generations. The reserve is also possible due to the massive effort of Fundacion ProAves, who currently are the owners of the reserve and have many years of experience in the conservation of birds in Colombia.

- Geographical location

The Natural Bird Reserve "Cucarachero del Chicamocha" is located in Zapatoca, at the East of the Andes of Colombia in the left side of the Sogamoso River (Fig 1.2). Zapatoca is located in the centre of Santander Department. It is situated to 60 km from Bucaramanga (the capital of Santander Department) via Chocoa-Giron, its altitude is approximately 1810 metres and it has an extension of 36019.21 hectares. Zapatoca bounded on the north by the municipalities of Betulia and Giron, on the east by San Vicente de Chucuri, on the east by the municipalities of Villanueva and Los Santos, and on the south by the municipalities of Barichara and Galan. Santander has a bimodal precipitation. In Zapatota, the periods of rains are April and May with precipitations of 139.1mm and 162.3mm and September and October with precipitations of 150,6mm and 180,1 mm. The water resource is limited and vulnerable in the dry season. The zone has three basins: Basin of Suarez river, Basin of Sogamoso River, and Basin of Chucuri river. The two properties: Lagunetas and La Cimarronera are in the Basin of Sogamoso River. This basin has a semicircular shape; the soils are well drained, with low fertility, highly eroded and rocky. Its semiarid characteristic is a result of different factors, such as geologic, climatic, and anthropogenic, which have contributed to the soil's degradation and the decrease in plant diversity. The flora that grows in the Chicamocha Valley is very diverse, especially in the Cactaceae family, which lacks a lot of research, and thorny shrubs. The lands are used for cattle and goat practices because of the aridity and xerofitic vegetation. The temperature is between 20ºC and 26ºC, the humidity is 65% to 70% and the evotranspiration is high.

The reserve covers an elevation gradient from 330 (Sogamoso river basin) up to 2000 meters of elevation (highest peaks). It is conformed by three main different habitats, covering 1300 hectares: 1) Riparian dry forest close to streams and the Sogamoso river between 330 and 1000 meters of elevation approximately. 2) Xerophitic shrubs and Cuji forest on small plateau areas and low slope mountains between 330 and 1200 meter of elevation approximately. 3) Mist forest 1200 to 2000 meters of elevation approximately.

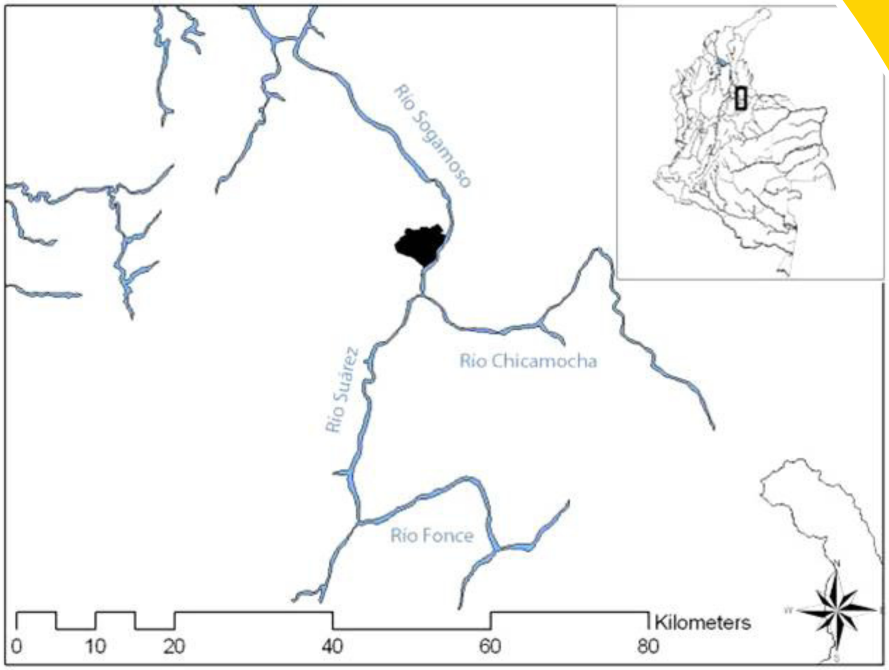


Figure 1.2. Main rives of the Chicamocha canyon. The Natural Bird reserve "Cucarachero del Chicamocha" is shown in back on the left side of the Sogamoso river.

ENSURING FINANCIAL SUSTAINABILITY FOR CHICAMOCHA NATURE RESERVE, THROUGH ESTABLISHING FACILITIES AS A FIELD RESEARCH STATION.

House facilities were improved for 12 researchers, conservation staff, and visitors at the reserve. These allow students and researchers to develop studies in the area. Field assistant also is working in the reserve to help students in their researches and to guide people through the reserve.

ProAves Foundation has bought, transported and installed a solar panel in the reserve (Fig 1.3A). This facility allows researchers and visitors to have energy supply. Additionally a horse was bought in order to facilitate the transportation of food and supplies from Zapatoca to the reserve. Proaves foundation also is establishing a nursery to raise native species in the future.

Fig 1.3. Picture taken by ProAves during the solar panel installation

1.2 MAPS OF THE RESERVE

A series of maps were development in order to create basic information regarding to elevation, river systems and records of species in the area. There was made a map that represented the different streams and rivers and the elevation structure in the natural bird reserve "Cucarachero del Chicamocha" (Fig. 1.4).

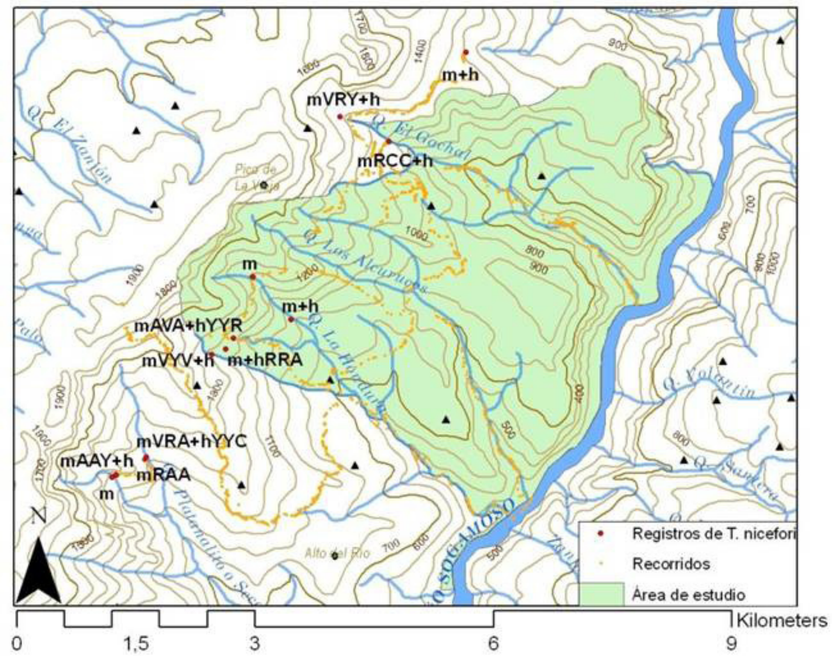


Figure 1.4. The map shows the river system and the elevation structure in the natural bird reserve "Cucarachero del Chicamocha". Red points and codes in black are some individual of Thryothorus nicefori found in the area.

Aditionally a 3D model of the Natural Bird reserve “Cucarachero del Chicamocha” was drawn as well as some pictures of the landscape and biodiversity in the area (Fig 1.5).

Figure 1.5. 3D model of the The Natural Bird reserve “Cucarachero del Chicamocha” and some pictures of the landscape and biodiversity in the area (Google Earth (Version 5.2.1.1588) [Software]. Mountain View, CA: Google Inc. (2010). Available from http://www.google.com/earth/index.html).

The access path to the house of the house of the natural bird reserve "Cucarachero Del Chicamocha", is showed in a map (Fig 1.6), and a loop from the Sogamoso river loop hike is also showed (Fig 1.7).

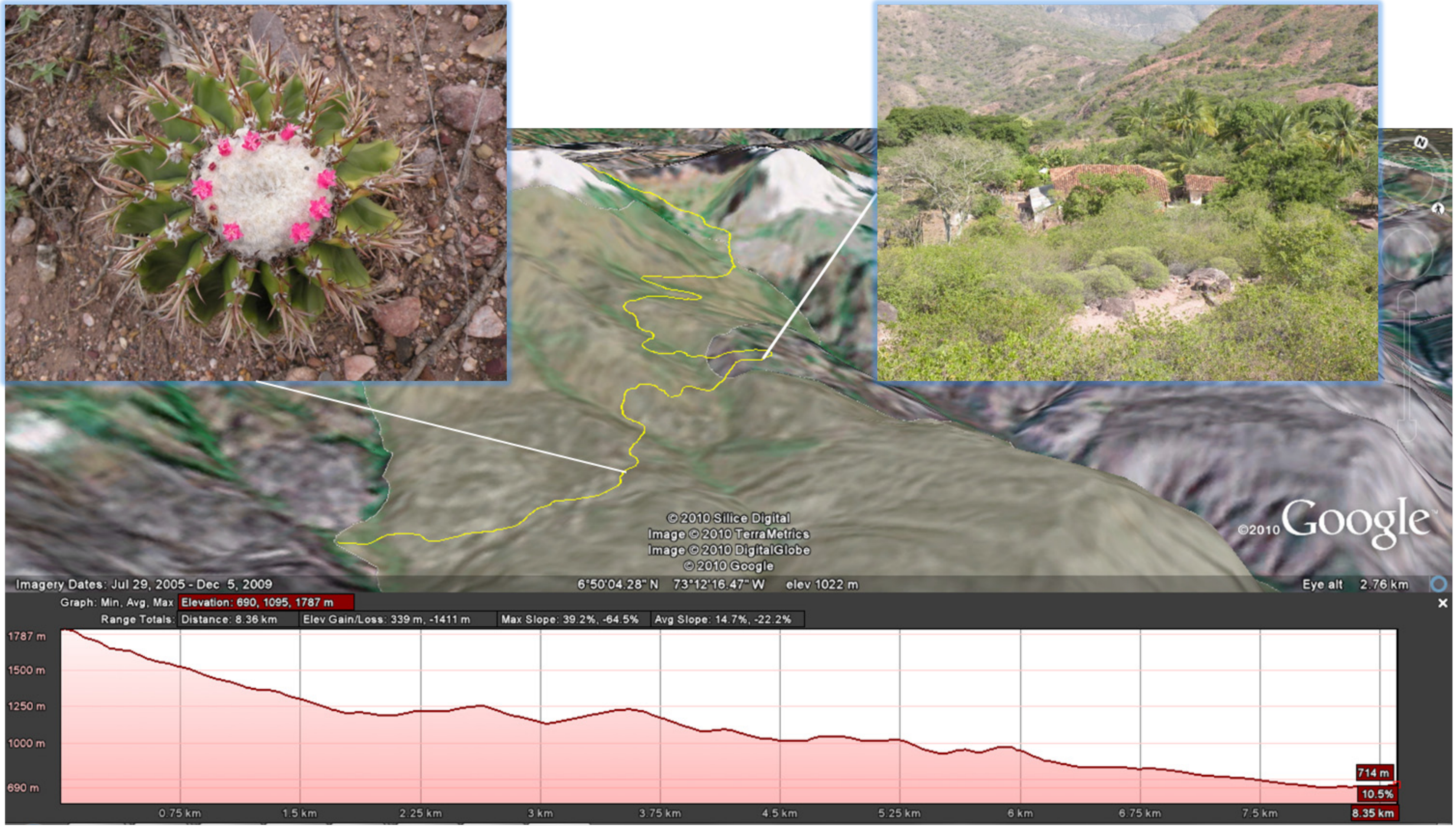


Figure 1.6. Access to the house of the natural bird reserve "Cucarachero del Chicamocha", path in yellow (Google Earth (Version 5.2.1.1588) [Software]. Mountain View, CA: Google Inc. (2010). Available from http://www.google.com/earth/index.html).

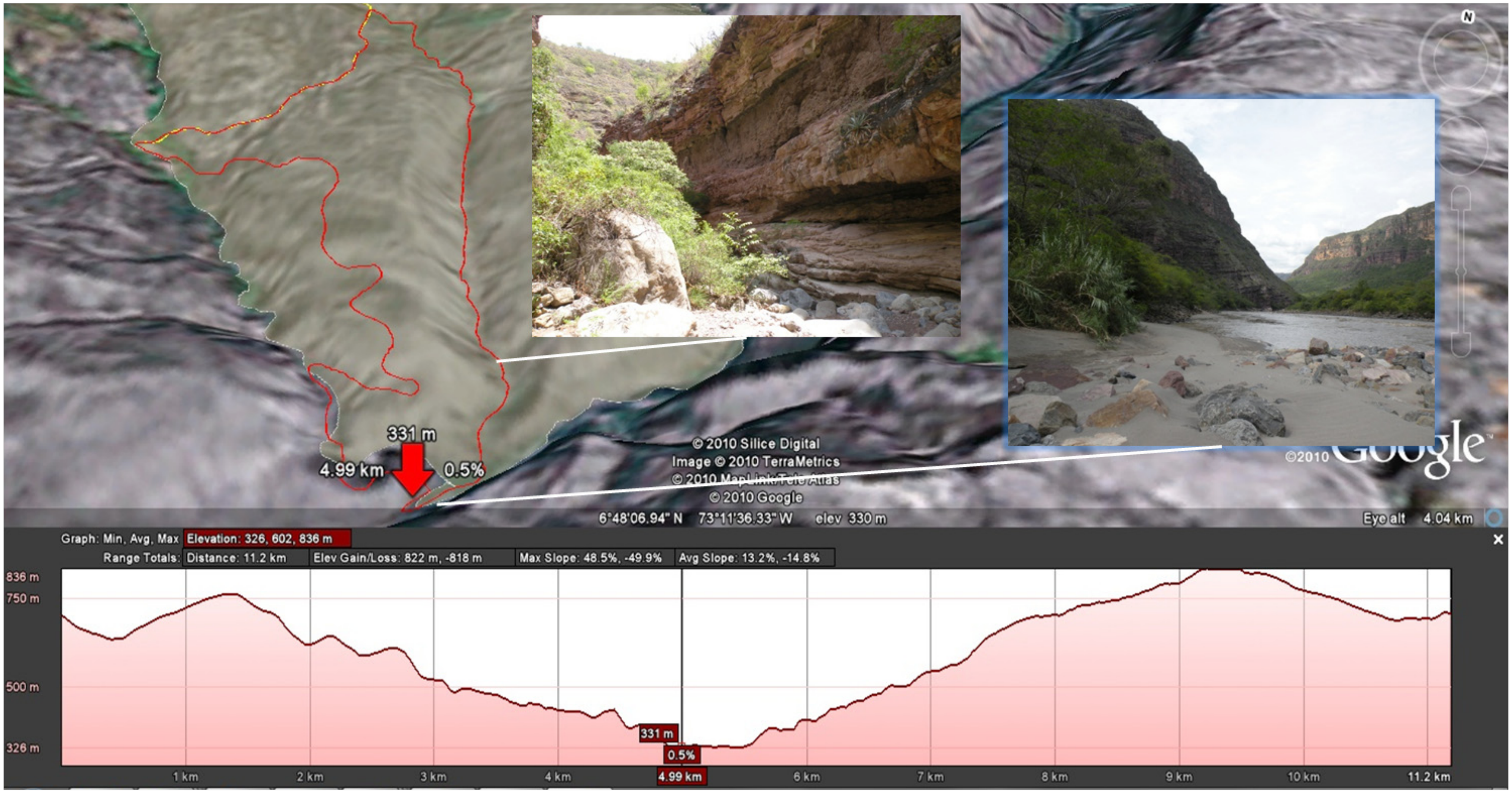


Figure 1.7. Sogamoso river loop hike in red is possible through the valleys of the streams in the natural bird reserve "Cucarachero del Chicamocha" (Google Earth (Version 5.2.1.1588) [Software]. Mountain View, CA: Google Inc. (2010). Available from http://www.google.com/earth/index.html).

1.3. RESTORATION PLAN OF THE CHESTNUT-BELLIED HUMMINGBIRD AND NICEFORO´S WREN NATIVE HABITAT.

INTRODUCTION

Vegetation in the Chicamocha canyon is mainly dominated by bushes, but there are some areas conformed by dry forests, cactus, and grasslands. The plant-richness in the Chicamocha is represented by 69 families of vascular plants, with 173 genera and 220 species. Moreover, there are endemic species of plants such as Zamia encephalartoides, Cavanillesia chicamochae, Melocactus guanensis, and Melocactus schatzlii subsp. Chicamochae (Albesiano 2006). Unfortunately, the dry forest of the Chicamocha canyon is an endangered ecosystem affected mainly by goat grazing and farming. These activities have contributed to loss the vegetation coverage and to increase the soil erosion changing dramatically the natural landscape. This modification in landscapes is the main cause of endemic species such as the endangered Niceforo's wren and the Chestnut-bellied hummingbird.

In this report, it is showed one of the main conservation actions for the Niceforo's wren and the Chestnut-bellied hummingbird: The establishment of the first protected area in the Chicamocha. However, the creation of protected areas needs to be complemented with restoration programmes focused on improving the endangered species habitats. A proper restoration process could facilitate the recovering of plants with some ideal characteristics to supply adequate conditions for these species. Some of these characteristics are: abundant litter production, higher growth capacity, large seed production, microorganism associations and grazing resistance.

In order to start planning a restoration programme using plant species with these qualities, it is important firstly to know the main plants which characterize the habitat of Niceforo's wren and the Chestnut bellied hummingbird, secondly to chose the plants which provide an ideal environment for these birds, and finally to study the capacity of germination of these plants to chose the best ones to be cultivated in nursery gardens for future restoration plans.

OBJECTIVES

- 1. Characterize the riparian and cuji forests vegetation composition in the natural reserve Cucarachero de Chicamocha.
- 2. Carry out germination tests on 12 plants from the habitat of the Niceforo's wren and the Chestnut bellied hummingbird
- 3. Build a plant nursery in the Natural reserve Cucarachero de Chicamocha.

METHODS

Characterization of vegetation

- Study Area

The study was carried out at the Naural reserve Cucarachero de Chicamocha from October 2008 to July 2009.

Ten transects of 50m x 2m were located in the riparian forest and cuji forest respectively. Trees and shrubs were censed and identified to the minimum taxonomic level (Gentry 1982). Samples collected were stored at Universidad de Pamplona herbarium.

● Species selection

Seeds of plants that provide several of the habitat requirements of Niceforo's wren and the chestnut-bellied hummingbird were chosen for the germination tests. For the cuji forest, the plants chosen were: Guazuma ulmifolia (guazimo), Pithecellobium dulce (gallinero), Pseudosamanea guachapele (igúa), Randia aculeata, Ficus cf. Hartwegii, Cnidoscolus urens, Zanthoxylum fagara, Piptadenia cf. uliginosa and Ruprechtia sp. Also, the selected plants at the riparian forest were: Celtis iguanae, Notopleura sp, Duranta sp.

Among the characteristics of these plants are: abundant litter production (measured through the tree crown size), higher growth capacity, large seed production, growth capacity in forest and eroded soils highly exposed to the light , microorganism associations and grazing resistance. It is important to note that not all the plants whose seeds were collected for the germination tests were covered in the transects.

● Germination tests

In order to identify the species with better capacity of growing in nurseries, different treatments were used to evaluate germination for each plant. Seeds were planted in three types of substrate combined with different treatments. In addition, a group of seeds were used as control planted in soil without compost and with compost (Table 1.1). Experiments were checked each day and the number of germinated seed was counted. A seed was considered germinated by its radical germination.

Table 1.1. Combinations between substrate type and kind of treatment for the chosen species for the germination tests

Substrate type	Treatment
	1) hot water
	2) mechanical scarification
1) soil without compost	3) sulphuric acid
2) soil with compost	4) white light
	5) darkness
	5) red light
3) cotton	6) blue light
	7) green light

● Nurseries initiation

The creation of a new nursery in the reserve was in charge of Fundacion ProAves. They adapted a room in the house as a nursery. Seeds collected from the reserve were planted in 500 bags, and excess of dung leaved by the goats were used as compost.

RESULTS AND DISCUSSION

● Characterization of vegetation

Species found in cuji forest and riparian forest are showed in table 2, and table 3 respectively. Results showed that the most abundant species at the cuji forest were Prosopis juliflora (cuji) with 46,5 percent of individuals, and Cereus hexagunus with 36,6 percent of the individuals. At the riparian forest the most abundant species was Notopleura sp with 21,86 percent of individuals. Margalef and Shannon diversity indexes were obtained for cuji and riparian forest; these indexes showed that the riparian forest has a higher diversity in comparison with the cuji forest (Table 1.4). The riparian forest could have a higher diversity because near to the water, soils have more nutriments and are more fertile supporting superior number of species (Albesiano 2006).

Previous studies done in the Chicamocha canyon report as the most abundant species: Stenocereus griseus, Lippia origanoides, and Prosopis juliflora (Albesiano 2006). Even when L. origanoides and P.juliflora were found in this inventory, it is important to note that only P.juliflora showed a higher abundance. On the other hand, S. Griseus was not collected.

Table 1.2. Abundance of plants species in cuji forest

Species	Abundance (Number of individuals)	Percentage of individuals
Acasia sp.	2	0,6
Cereus hexagonus	115	36,6
Pithecellobium dulce	20	6,4
Prosopis juliflora	146	46,5
Senna sp.	14	4,5
Zanthoxylum fagara	17	5,4
Total	314	100

Table 1.3. Abundance of plants species in riparian forest

Species	Abundance (Number of individuals)	Percentage of individuals
Acalypha sp.	1	0,22
Adenaria floribunda	11	2,38
Anacardium excelsum	12	2,60
Ardisia sp.	7	1,52
Arrabidaea sp.	2	0,43
Asteracea sp. Indet.	2	0,43
Aulonemias sp.	25	5,41
Buddleja americana	3	0,65
Bursera simaruba	4	0,87
Byrsonima crassifolia	5	1,08
Calliandra sp.	37	8,01
Calycolpus moritzianus	45	9,74
Capparis sp.	3	0,65
Casearia sp.	33	7,14
Cecropia sp.	9	1,95
Celtis iguanae	2	0,43
Chrysophyllum auritum	1	0,22
Clusia celiae	8	1,73
Critoniella sp.	9	1,95
Eirmocephala sp.	1	0,22
Erythrina poeppigiana	1	0,22
Erythroxylum sp.	3	0,65
Eschweilera sp.	1	0,22
Eugenia sp.	1	0,22
Ficus americana	3	0,65
Ficus hartwegii	1	0,22
Inga sp.	4	0,87
Lantana sp.	3	0,65
Lippia origanoides	1	0,22
Machaerium capote	4	0,87
Machaerium sp.	4	0,87
Machaerium microphyllum	2	0,43
Maclura tinctoria	2	0,43
Miconia albicans	11	2,38
Miconia rubiginosa	1	0,22
Myrcia fallax	6	1,30
Myrsine pellucida	101	21,86
Notopleura sp.	31	6,71
Onoceris purpurea	3	0,65
Palicourea sp.	5	1,08
Persea americana	1	0,22
Persea caerulea	1	0,22
Piper aduncum	2	0,43
Piper sp.	1	0,22
Psidium guineense	2	0,43
Rolandra sp.	3	0,65
Sageretia sp.	1	0,22
Spondias mombin	17	3,68
Stemmadenia grandiflora	2	0,43
Theobroma cacao	1	0,22
Trichanthera gigantea	2	0,43
Vernonanthura sp.	10	2,16
Vismia vaccifera	11	2,38
Total	462	100

Table 1.4. Diversity indexes in cuji and riparian forest

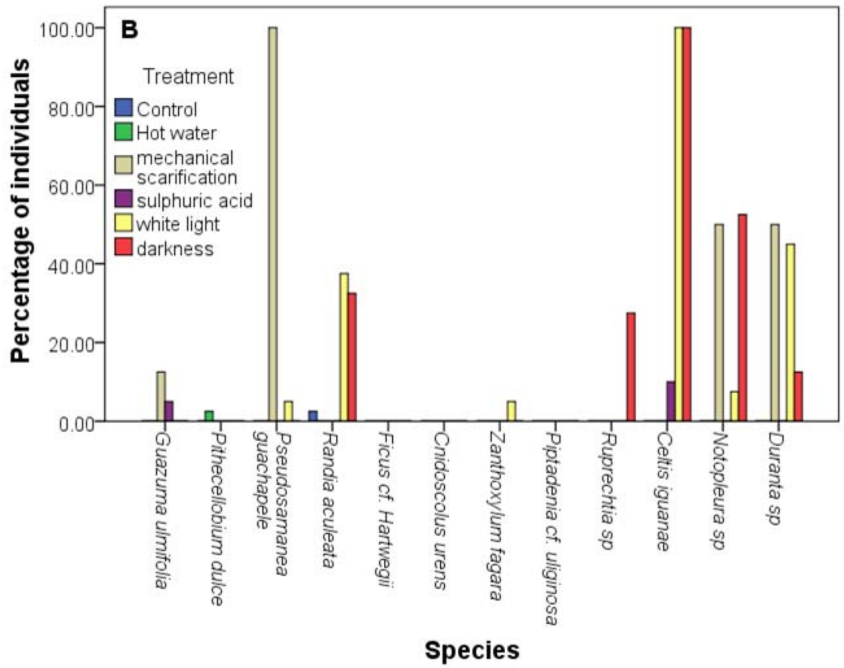
Diversity index	Cuji forest	Riparian forest
Margalef	0,99	3,27
Shannon	0,54	2,10

● Germination tests

Results show the percentage of individuals germinated for each treatment in different substrates (Figure 1.8).

The plants that responded better to germination tests which could be performed in nursery conditions were: P.guachapele, which responded very well to mechanical scarification in the two types of soils. Duranta sp. not only grew satisfactory in soil lacking of compost located in darkness, but also responded well to white light in both substrates, and to mechanical scarification in soil with compost. C. iguanae showed a high percentage of individuals germinated when was treated by mechanical scarification and white light in soil with compost. Finally, Notopleura sp. reacted very well to the red light in cotton, and mechanical scarification and darkness in soil with compost.

These results show that these species had a favourable growth in nursery conditions, which indicates that they could be used in future restoration plans. Besides of being ideal to cultivate in nurseries, these plants offer good characteristics for the habitat of Niceforo's wren and the Chestnut-bellied hummingbird.



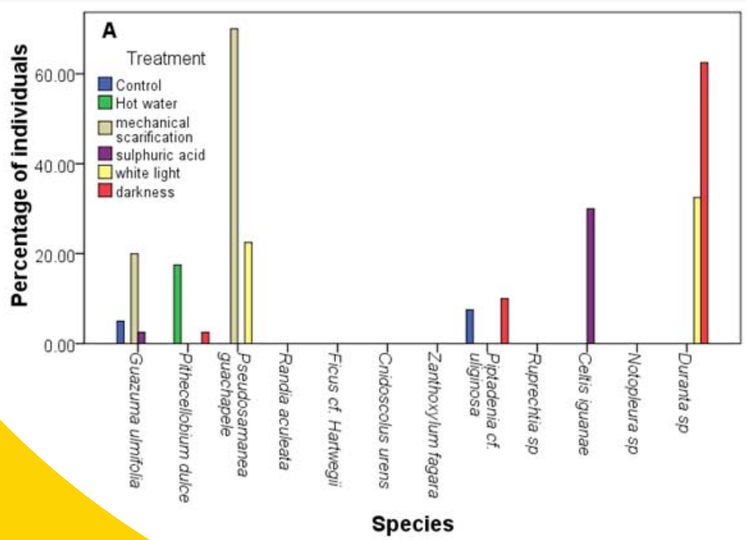


Figure 1.8. Percentage of individuals germinated of 12 plants exposed to different treatments in: A. Soil without compost, B. Soil with compost, and C. Cotton.

- Nurseries initiation

The photos shows the initiation of a nursery in the natural reserve cucarachero de Chicamocha by Fundacion ProAves (Figure 1.9). They began planted native plants while the germination tests carried out by students of the Project Chicamocha showed results.

Figure 1.9. Photos taken by Proaves foundation during the nursery estab-lishement in the Natural Reserve Cucarachero de Chicamocha.

RECOMMENDATIONS

For future restoration plans, we recommend to Fundacion ProAves, the use of the following plants in their nurseries: P.guachapele, Duranta sp., C. Iguanae, and Notopleura sp. These plants not only provide a good environment for the habitat of Niceforo's wren and the Chestnut bellied hummingbird, but also they can be managed easily in the field and laboratory conditions.

1.4. CONSERVATION STRATEGIES FOR THE CHICAMOCHA CANYON

One of the objectives of the Chicamocha Project was to cooperate in protecting conservation targets Chestnut-bellied Hummingbird and Niceforo´s Wren in the Chicamocha canyon. To achieve this purpose, we participated in the creation of an inter-institutional alliance.

This alliance was created in September 2009 by a group of institutions among which is the Fundación Conserva, Fundación Natura, Fundación Neotropical, Fundación Chimbilakos and Fundación ProAves and the Botanical Garden Eloy Valenzuela, Bucaramanga.

As a contribution of the alliance, the Chicamocha project donated the project logo to transform this in the institutional image of the alliance (Fig 1.10).

Fig 1.10. Logo of the Chicamocha alliance.

The Chicamocha alliance will work together to join efforts through human, scientific, technological and financial resources in order to design participatory strategies for the management and territorial sustainable development in the basin of the river of the Chicamocha canyon.

The main objectives of the alliance are:

- 1. Promote and disseminate the alliance.
- 2. Identify the needs of the buffer zone of the reserve and look for ways to strengthen them.
- 3. Evaluate the possibility of buying land in the canyon of Chicamocha.
- 4. Arouse interest and generate commitment from the regional autonomous corporations.
- 5. Consolidate ourselves as managers of process focused on conservation in the Chicamocha Canyon region and its ecosystems.

Currently, the Chicamocha Alliance through the Natura Foundation and the Neotropical Foundation is participating in the planning of a Community reserve in the basin of the river Umpala located in the Chicamocha canyon. To support this initiative, a member of the Fundacion Conserva was worked in the region collaborating in herpetofauna inventories.

CONCLUSIONS

The most important objective of the Chicamocha Project II was achieved with the creation of the Natural Reserve Cucarachero del Chicamocha. Under ProAves Fundation management this reserve will constitute the first step in the struggle again the extinction of two endemic species of the Chicamocha canyon: the Niceforo's Wren and the Chestnut-bellied hummingbird.

Additionally, through this project it was possible to define some important strategies for the conservation of these threatened species. Some of them are the results of a study in restoration potential of native species of plants which pointed out the potential of P.guachapele, Duranta sp., C. Iguanae, and Notopleura sp, the creation of an alliance among NGOs working in the dry forest conservation, which can enhance the outputs in the region joining efforts and defining priorities.

CHAPTER TWO

Proyecto Chicamocha Colombia

Promoting Awareness In Biodiversity Conservation And Natural Resource Richness In The Dry Forest, Santander, Colombia

By
Alexandra Delgadillo, Marcela Beltrán, Jorge Parra, & Diana Guzmán

One of the most important objectives for the Chicamocha Project is to achieve the environmental education programme in the Chicamocha canyon. Between 2004 and 2006 were visited nine schools belong to nine municipalities in Santander and Boyacá. From 2008, the project is focusing on the environmental education activities in Zapatoca municipality Santander, to aware the local community about the new protected area created "Reserva Natural de Aves: Cucarachero del Chicamocha". We have been working in six schools where children are involving in specific educational workshops. In addition, we carried out an ecological workshop with the aim to generate in Zapatoca inhabitants awareness about some environmental issues like endangered bird species, natural resources and biodiversity importance of the region. These activities constituted the first approach to local communities living near the natural reserve and were an opportunity to share with them the creation of the reserve and to hear about their concerns.

A calendar and a brochure were designed with conservation messages which were printed and given out in Santander and Boyacá departments. The Chicamocha team also participated in local television and radio interviews, where was shared our experience in the region, talking about Amazilia castaneiventris and Thryothorus nicefori requirements as well as about the need to protect the regional biodiversity and natural resources. Besides, in order to obtain professional advice and meet researchers working on the same topics, The Chicamocha Project have participated in international and national meetings and launched a website blog with information about the project achievements.

Finally, as a result of the last six years working in conservation, the Chicamocha team made the decision to create a new NGO called "Fundacion Conserva" whose main objective is to work in the conservation of tropical species and ecosystems, providing scientific research, environmental education tools and sustainable development projects to local communities in Colombia.

INTRODUCTION

In order to obtain a long-term conservation strategy, it is necessary to involve local communities in conservation projects, so they will generate a sense of ownership for local resources, the network among the species for ecosystem functionality and the environmental services that ecosystems provide to them. Project Chicamocha have been working to promote children and community awareness in Zapatoca for some reasons:

- In this municipality is located one of the last pristine dry forest in the Chicamocha Canyon which is the habitat of two endangered species of birds, Amazilia castaneiventris and Thryothorus nicefori.
- There is a new natural reserve in this region and it is important that people don't feel threatened about their new neighbors and on the contrary people realize that is a good opportunity to be involved in the protection to natural resources.
- Learning about the life history and function of animals and plants in its ecosystems helps children and peasants to be awareness about the environment and become them in guardians of the nature.

AIM

- To carry out workshops in 6 schools in order to give children and teachers the opportunity to know more about regional biodiversity, the natural reserve "Cucarachero de Nicefori" and species in danger of extinction.
- To share with local community, through an ecological workshop, the creation of Cucarachero de Nicefori reserve and to know about people point of view regarding to ecological problems in the region.
- To promote environmental awareness about the ecological function of plants and animals inhabiting dry forest and its importance to community.
- To give to know our results in different environments through national and international meetings, blogs and publication, in order to obtain feedback on our work.

Workshops carried out at Zapatoca Municipality's Schools

METHODS

We used the approach method to link this awareness project with children, teachers and inhabitants from the Zapatoca village.

- Approach to children: In agreement with the rural schools coordinator we chose 6 schools belonging to Zapatoca municipality. We did two workshops in each school to develop our awareness work.
- Approach to teacher: In each school we gave to each teacher pedagogic material to reproduce workshops and additional bibliography and answer questions about the talks given.
- Approach to local inhabitants: We gave out awareness material (calendars and brochures) through The Chicamocha canyon. In Zapatoca we organized an ecological workshop, participated in a Radio program and had an interview in a TV program.

ACTIVITIES AND RESULTS

2.1 WORKING WITH SCHOOLS

The total number of children included in these activities was 158 who were between 5 and 16 years old. Students were enrolled from kindergarten to post-primary. The table Nº 1 provides the data of schools and teachers visited.

Table Nº 1.
Data of schools visited during the Chicamocha Project II in the Zapatoca municipality.

School name	Number of students	Number of teachers	Students range of ages
El Carrizal	13	1	5-10
El Fical	11	1	5-12
San Isidro	20	1	5-13
Sede A Las Puentes	64	2	5-16
Sede G La Guayana	22	1	5-12
Sede J El hato	28	1	5-12

Workshop 1: Knowing the dry forest

The first workshop was named “Knowing the dry forest” and had as main objective to give teachers and students information about the Chicamocha Project and teach them the principal characteristics of the dry forest and what species inhabit in this ecosystem.

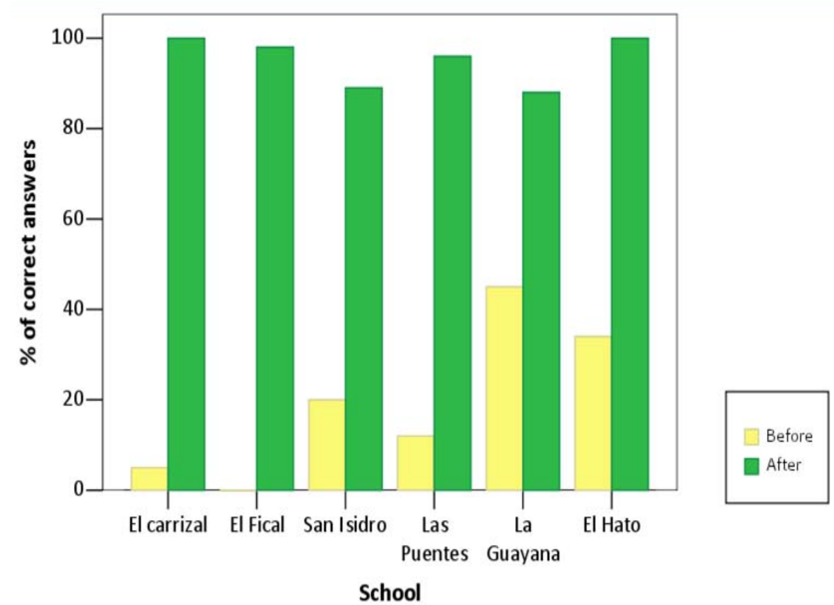
In order to determine a priori students’ knowledge about these topics we did a diagnostic activity previously to the workshop. This activity consisted in a drawing in which children drew plants and animals inhabiting the dry forest in the Zapatoca municipality. The diagnostic activity was done in our first visit to schools, and allowed us to realize that children’s knowledge was limited to domestic animals and with some specific exceptions they didn’t know wildlife animals like porcupines and armadillos.

After that, we presented a talk about the dry forest biodiversity. Using a Colombian map we located geographically the Zapatoca municipality, the Chicamocha Canyon and the main rivers. Then, we explained what the dry forest is, what its characteristics are and what things make this ecosystem unique (like vegetation, humidity, temperature, etc). Through a simple language we share with teachers and children what species of birds, mammals, reptiles and plants inhabit dry forest and their ecological function.

To reinforce the acquired knowledge and to evaluate the workshop we did a final game named “What the dry forest told me”. This game was a race with several stations. At each station, each of the groups received a question which had to be filled to move to the next station. The tests consisted in questions or drawings based on what was explained in the talk. As the contestants were able to finish the race, they received the booklet “The inhabitants of the dry forest.”

The Fig. Nº 1 shows the percentage of correct answers obtained before and after the activity when we asked children for giving at least three wild species inhabiting the dry forest. As it is possible to observe in the chart, children improve significantly their knowledge about the dry forest biodiversity. In addition, students showed enthusiasm to learn about nature and animals and enjoyed the activities.

Fig. Nº 1. Percentage of correct answers obtained before and after the workshop when we asked children for giving at least three wild species inhabiting the dry forest.



Workshops carried out at Zapatoca Municipality’s Schools

Workshop 2: The dry forest needs our help

The second workshop was named “The dry forest needs our help” and had as aims to share with children and teachers the creation of the natural reserve “Cucarachero de Nicefori”, to assess the impact of the first workshop and to generate awareness about current dry forest situation and how we can help to preserve this ecosystem. To achieve these objectives, we presented a talk about what a natural reserve is and why it is important and we explained the ecological requirement of some endangered species inhabiting the dry forest.

In addition, we generated a discussion space about how children and their parents can help to protect the dry forest and wildlife animals.

During the second visit, we accompanied each talk with recreational activities like plasticine, drawing, painting and origami. Each of them related with the topics explained during the presentations. At the end of this workshop, students organized in the blackboard a summary of things learned.

In order to evaluate the impact of this workshop we evaluated the knowledge that children acquired during the activities. These results are summed up in the Fig. Nº 2 which provides information about the knowledge of children in relation with the concept of a natural reserve, the characteristics of the Niceforo’s Wren and the Chestnut-bellied Hummingbird.

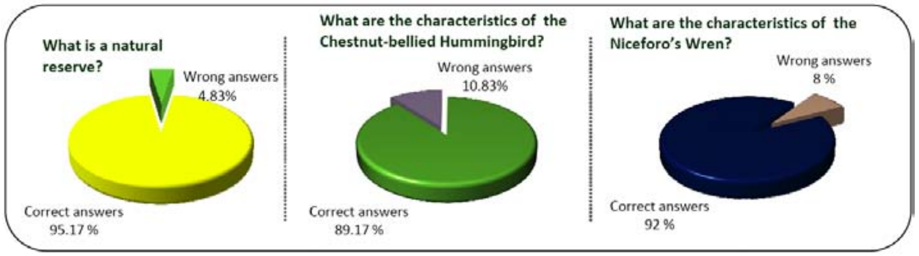


Fig. Nº 2
Local children’s knowledge on natural reserves and the characteristics of the Chestnut bellied hummingbird and the Niceforo’s wren. Results were evaluated after the second workshop and sum up the six schools visited.

Finally, during the second visit to schools we provided teachers with bibliographic material related with dry forest’s flora and fauna, as well as pedagogical resources like draws, games, and all the activities done during our workshops. The idea is that each teacher can be able to reproduce this experience in the future and this awareness work can continue with the next generation of students.

In all schools children and their teachers were receptive to the activities proposed by the workshops leader and expressed interest in the talks and play activities. In schools that had been visited previously it was found that children remembered the general information covered in the first workshop and wanted to know more about the dry forest and the species that inhabit it.

It could also be verified that after the workshop children were able to distinguish the characteristics of Amazilia castaneiventris y Thriothorus nicefori, to define what a natural reserve is and to answer why is important to protect plants and animals inhabiting the dry forest.

Workshops carried out at Zapatoca Municipality’s Schools

Ecological workshop with local comunity

2.2 WORKING WITH LOCAL COMMUNITY

Ecological Workshop:

A workshop with local community was planned in Zapatoca. Two weeks before, we published 100 advertisements around the town and visited shops and public places to encourage people to participate. The workshop was named “Zapatoca and its biodiversity”, and our idea was to give people a talk involving several environmental topics:

- The natural reserve “Cucarachero Del Chicamocha”: A new Natural reserve in Zapatoca. What is it and why is it important?
By: Manuel Meneses, forest ranger, Fundación ProAves. Manuel took about their personal experience as a forest ranger, and what the objectives of the reserve are.
- Bats in the Chicamocha canyon: Are they dangerous or can they help us?
By: Manuel Rodríguez, president, Fundación Chimbilako. Manuel presented a talk about the ecological importance of bats, their natural history and some misconceptions about.
- Fires: causes, consequences and how to prevent them.
By: Nestor Macias, member, Defensa civil colombiana. Nestor explained the different kinds of fires, causes and ways to prevent them.
- Project Chicamocha II: Saving the dry forest biodiversity.
By: Jorge Parra, team leader, Chicamocha Project. Jorge showed the Chicamocha project aims and achievements as well as the dry forest features and some strategies to protect it.
- Participants’ opinion and comments. This space gave people the opportunity to ask and give their opinion about the topics explained.

The whole workshop was broadcasted by a regional channel and had the participation of some stockbreeders, teachers, and local people interested in ecological topics.

One of the main problems that local people perceived and shared during the workshop was a decrease in water supplies which is in many cases accompanied by water pollution in the region. Furthermore, they feel that there are few economical opportunities in the region.

Radio Interview

The Chicamocha team and two members of the Fundacion Chimbilako attended to a radio program in which they answered questions from listeners about the Chicamocha project work in the region. Additionally it was explained some further characteristics of the dry forest ecosystems and its inhabitants.

Television Interview

The Chicamocha Project and Fundacion Chimbilako gave an interview by an institutional channel in Zapatoca. During the interview, we announced the creation of the ProAves’ new natural reserve “Cucarachero Del Chicamocha and spoke about the importance of protecting the dry forest and the work that the project Chicamocha has been conducting in the region. Additionally, Fundacion Chimbilako gave their work to know and talk about their researches and education programs with bats.

Establishing calendars and brochures

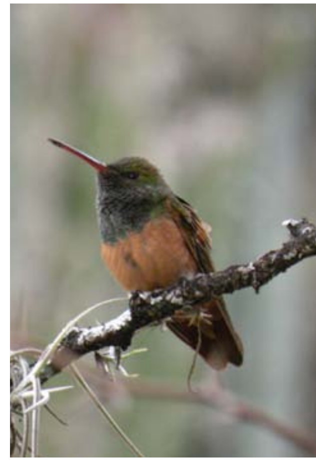
To familiarize people with the fauna and flora endemic to the region, we designed a calendar which was given out across the Chicamocha Canyon. Besides, the calendar provides pictures of Amazilia castaneiventris and Thryothorus nicefori. Through this calendar we hope people begin to value the biological heritage of the region and the importance of taking care of them (Fig. Nº 3). In the same way, we decided to design a brochure with general information about some species inhabiting dry forest in the Chicamocha Canyon (Fig. Nº 4); this brochure was written in a simple language in order to be easy to understand for children and peasants. The chosen species were:

- *Cavanillesia chicamochae*: Endemic plant of the Chicamocha canyon, listed as an endangered species. The known populations of Cavanillesia chicamochae are isolated in a very dry Chicamocha River Canyon, away from humid or sub humid forests. According to local people, the species was more abundant in the past and is restricted to rocky ledges. Moreover, the presence of goats in the region affects this species as they consume softwood logs and young seedlings.

- Niceforo's wren, *Thryothorus nicefori*: Niceforo's Wren is a songbird endemic to the Neotropical dry forest of the Chicamocha Valley in Colombia (Hilty and Brown 1986). Niceforo's Wren is restricted to the riparian forest fragments in the Chicamocha region at elevations between 1132 and 1840 m (Valderrama et al., 2007). The World Conservation Union (IUCN) designates Niceforo's Wren as a Red listed critically endangered species because of ongoing anthropogenic habitat modification (IUCN 2006).

Cavanillesia chicamochae

Momotus momota olivaresii



Amazilia castaneiventris

Myiarchus apicalis

- Chestnut bellied hummingbird, *Amazilia castaneiventris*: it is an endemic species from the Chicamocha Valley in the east Andes of Colombia (Hilty & Brown 1986). This species is Critically Endangered because it has an extremely small known range and its suitable habitat is severely fragmented and is declining at the moment (IUCN Red List 2004). This species is restricted to the departments of Santander and Boyacá were had been recorded only a few times (BirdLife 2004, Renjifo et al. 2002).

- Blue-crowned Motmot, *Momotus momota olivaresii*: it is an endemic subspecies of Chicamocha canyon in Colombia, which has a large range (BirdLife International 2004; Fig. 6). The global population size has not been quantified, but it is believed to be large as the species is described as 'common' in some parts of its range (Stotz et al. 1996). M. momota olivaresii is commonly found in the higher parts of thorny shrubs, and occasionally nests near houses and the coffee plantations (Parra et al, 2006).

- Apical Flycatcher, *Myiarchus apicalis*: it is endemic to Colombia. This species has an estimated global extent of occurrence of 42,000 km_ (BirdLife International 2004). The global population size has not been quantified, but it is believed to be large as the species is described as 'frequent' in parts of its range (Stotz et al. 1996). It is found in dry thorny shrubs in the canyon, open areas, and also in coffee plantations hunting insects. Its presences can be classified as "common" (Parra et al, 2006).

● Bicoloured Wren, *Campylorhynchus griseus bicolor*: it is other endemic subspecies of Chicamocha canyon in Colombia. The global population size has not been quantified, but it is believed to be large as the species is described as 'common' in some parts of its range (Stotz et al. 1996). It is common in plantations with living fences and in trees in this region. Its particular song is very well known by the people, who commonly call it "cuchica", and it builds its communal nests near houses and parks of the nearby towns (Parra et al, 2006).

● Troupial, *Icterus icterus*. On 12-18 November 2004, at Finca Lagunetas, Municipio of Zapatoca, Departamento de Santander, we observed and heard several Troupial individuals. They were usually seen in pairs, sometimes accompanying mixed-species flocks on arid scrubs and columnar cacti, foraging on fruits and insects. Vocalizations of this species were heard early in the morning and at noon, decreasing drastically in the afternoon (Parra et al, 2006). This species is settled in the Guajira (south east base of the Sierra Nevada de Santa Marta) and north of Arauca and Vichada (Hilty & Brown 1986).

● Bicolor-spined porcupine, *Coendou bicolor*: this species of rodent is endemic to the Neotropical region, being found in Bolivia, Colombia, Ecuador and Peru. Its body is cover with spines and has a prehensile tail. Currently is listed as least concern in the UICN Red list (IUCN, 2010). We observed this species in the natural reserve Cucarachero Del Chicamocha, near to a stream.

● *Tetrioscincus bifaciatus*: it is a common reptile species with diurnal and terrestrial activity. This lizard has the ability to drop its tail as antipredator strategy. It feeds on insects and small arthropods actively pursued within the litter. This species lives in the Caribbean coast and the Magdalena Valley in Colombia and Venezuela. Currently this species in not included in the IUCN Red list (Rodriguez et al., 2008).

Coendou bicolor

Tetrioscincus bifaciatus

Icterus icterus

Fig. Nº 3. Project Chicamocha Calendar gave out in the Chicamocha Canyon region

Aquí encontrarás algunos de los habitantes del bosque seco

¡Conócelos!

El bosque seco del Chicamocha es un lugar único en Colombia en donde viven animales, como el colibrí ventricastaño, el cucarachero de Nicéforo y plantas como el barrigón, que no es posible encontrar en otro lugar del mundo.
En el bosque seco la mayoría de los árboles pierden sus hojas en verano, aportando nutrientes al suelo y durante el invierno nacen nuevas hojas, haciendo que en cada estación el bosque parezca un lugar diferente.

CUCARACHERO *(Thryothorus nicefori)*
El Cucarachero de Nicéforo es un ave que vive entre los matorrales al lado de quebradas y se alimenta de cucarachas y mosquitos. Generalmente tiene una sola pareja durante toda su vida y defiende su territorio y sus nidos cantando para evitar la entrada de otros intrusos.

Esta especie es muy importante porque ayuda a controlar las poblaciones de cucarachas y otros insectos evitando así que estos lleguen hasta nuestra casa. Además este cucarachero solo se encuentra en el Cañón del Chicamocha y está a punto de desaparecer porque los lugares en los que habita se están acabando.

COLIBRÍ ventri castano *(Amazilia castaneiventris)*
El Colibrí Ventricastaño es una quincha que se alimenta del néctar de las flores y a veces de zancudos. Se puede observar defendiendo su territorio cantando y luchando con otras quinchas durante las épocas de lluvia. Cuando llega la época del verano entre diciembre y marzo, el colibrí ventricastaño migra a lugares menos secos y calientes y regresa en la época de lluvias al mismo territorio en el que vivía antes.

TOCHE *(Icterus icterus)*
Tiene un hermoso cantar y se alimenta de frutas. Una de sus principales funciones en el bosque es ayudar a dispersar las semillas para que crezcan nuevos árboles.

CARPINTERO *(Melanerpes rubricapillus)*
Pasa la mayor parte del día picoteando sobre los troncos de los árboles en busca de los insectos que viven allí. De esta manera combate algunas plagas que hacen daño a los árboles.

ÁGUILA
(Buteo magnirostris)
A las águilas les gusta volar muy alto, se posan sobre ramas altas para cazar su alimento que por lo general son ratas y ratones, evitando que estos entren a las casas de la gente.

ATRAPAMOSCAS *(Myiarchus apicalis)*
Como su nombre lo indica se alimenta de moscas y mosquitos, previniendo que estos piquen a la gente y así transmitan graves enfermedades.

CUCHICA *(Campylorhynchus griseus)*
En su hábitat natural se come los huevos de otros pájaros evitando así que éstos se vuelvan plagas. Para que no se coma los huevos de las gallinas es importante cerrar bien los gallineros.

PUERCO ESPIN
(Coendou bicolor)
Vive en huecos que el mismo hace en la tierra, come frutas y ayuda a dispersar las semillas. Tiene espinas que le sirven para defenderse.

Protegiendo el bosque seco y los animales que viven en él podremos asegurar que nunca nos falte el agua y que nuestros hijos puedan disfrutar de su belleza.

Tu también eres un habitante del bosque seco,

¡¡¡cuídalo!!!

fundación conserva — IDEA WILD — BirdLife International — bp — Conservation Leadership Programme

Fig. Nº 4. Brochure shared out across the Chicamocha canyon.

Production and distribution of calendars and brochures

950 calendars and 500 brochures were given out in 7 municipalities of Santander, 2 municipalities of Boyacá and some foundations located in Cali and Bogota (Fig. 5, Table 2).

Table N° 2.
Places in the Chicamocha canyon region where brochures and posters were distributed.

Department	Municipalities	Institutions
Santander	Galán, Pinchotes, San Gil, Zapatoca, Villanueva, Barichara, Socorro.	Mayor's offices, schools, NGOs. Local community.
Boyacá	Soata, Susacon	Mayor's offices, schools Local community.
Valle del Cauca	Cali	WCS, Calidris
Cundinamarca	Bogotá	Fundación Natura, Conservación Internacional, Universidad de los Andes, Asociación Colombiana de Ornitología ACO.

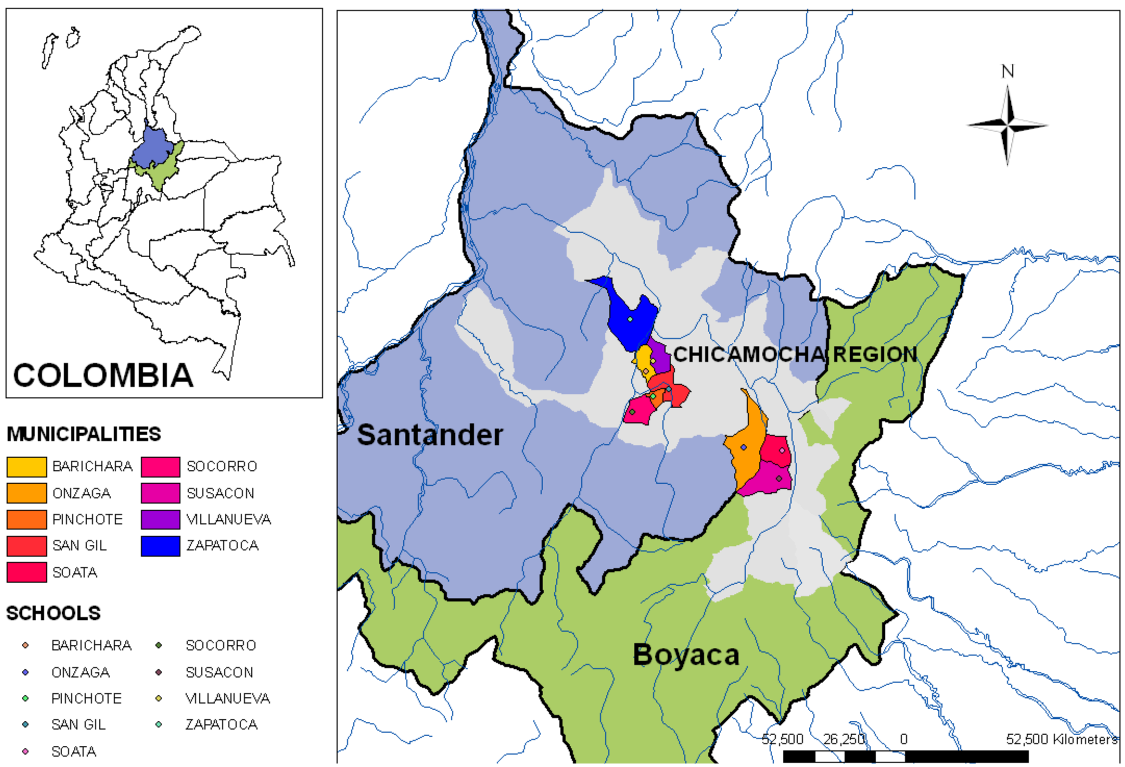


Fig. N° 5.
Municipalities in Santander and Boyacá where the calendar and the brochure were distributed.

2.3 NATIONAL AND INTERNATIONAL MEDIA CAMPAIGN FOR DRY FOREST CONSERVATION

- Chicamocha project's blog

Additionally to our work with the local media in Zapatoca, we launched the Project Chicamocha blog (*http://proyectochicamocha.blogspot.com/2009_09_01_archive.html*). Through this space we are announcing news related with advances in our project and sharing pictures and videos of the Chicamocha Canyon biodiversity. This blog aims to share information about studies and actions on conservation in the Chicamocha dry forest, and visitors can comment, link to us or write a message to the Chicamocha Project (Fig N° 6).

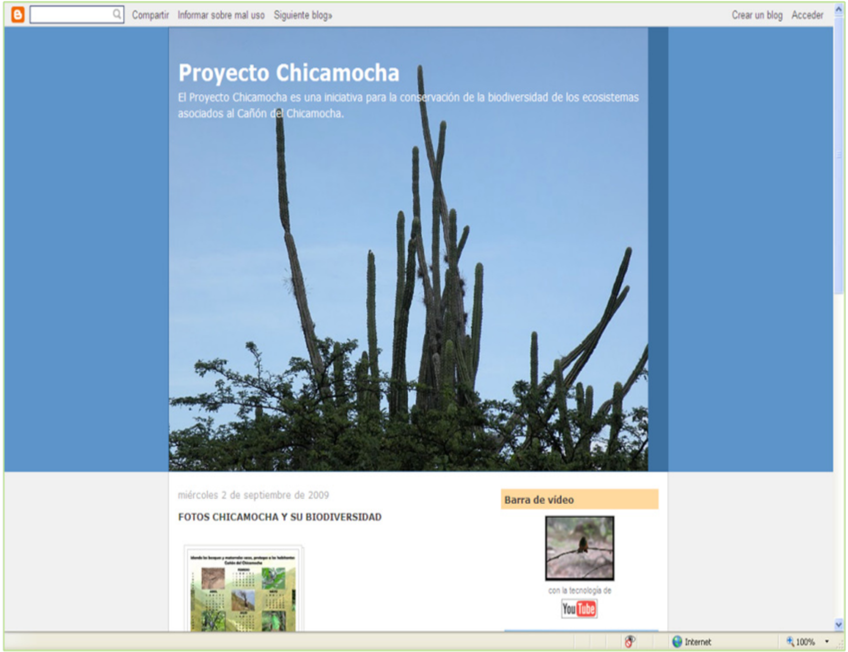


Fig. N° 6. Chicamocha

Scientific diffusion

In order to receive advices and guide from experts to improve our researches we have attended to national and international meetings. These conferences have enabled us to meet other people working on the same areas, who have been valuable to provide us new ideas and methodologies to implement in our work.
International congress:

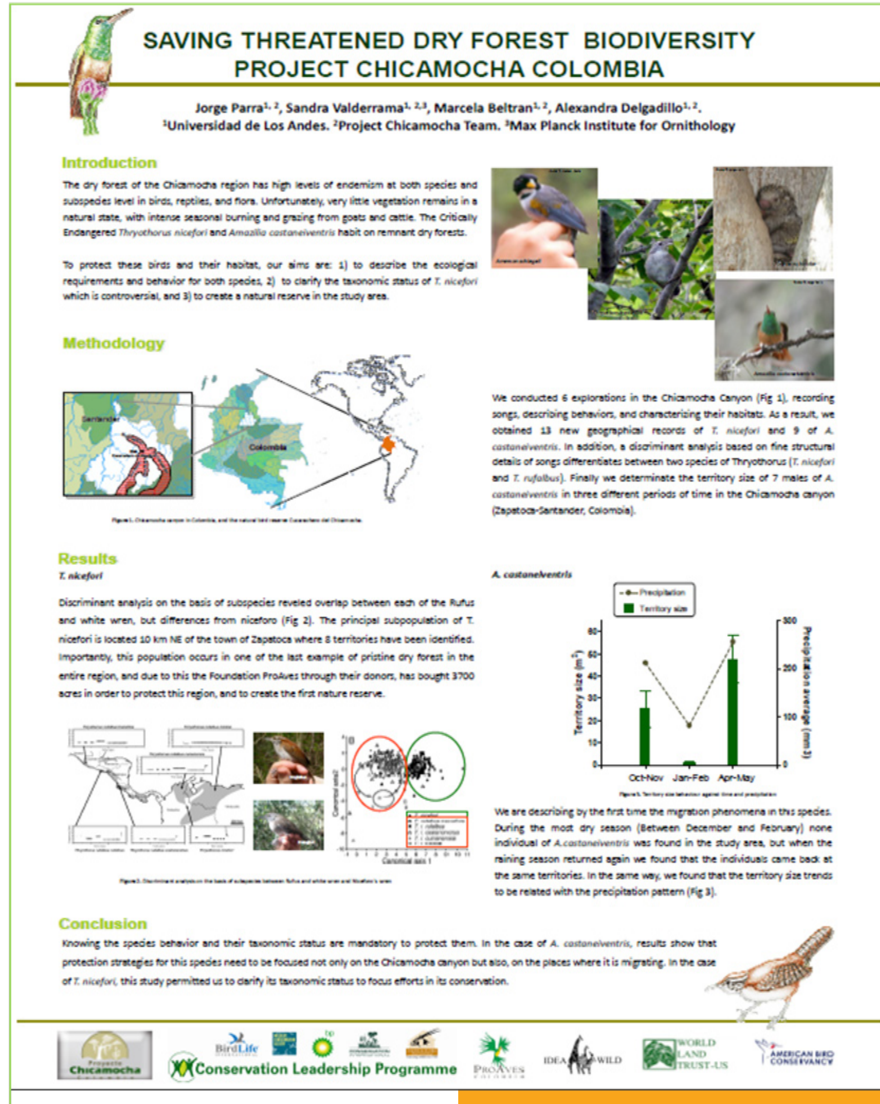
- Speech

Facing Chicamocha dry forest conditions: Behavioural strategies of the Endangered Chestnut-bellied hummingbird in Colombia. XXIV International congress for conservation Biology. Endmont, Canada. 2010.
Abstract:

> *The chestnut bellied hummingbird is a global endangered species endemic of the Chicamocha canyon in Colombia. Studies about its ecological requirements are scarce to understand and predict its necessities in order to protect it. Hence, this study pretends to establish the main behavioral strategies of the endangered Chestnut bellied hummingbird to face current seasonal changes in the Chicamocha dry forest. Additionally, to determine how the seasonality affect its competitors (hummingbird community) during the year. Seven male territories were located in a recently created natural reserve in the Chicamocha canyon Colombia. For each male were measured territory area, flower density, and time budgeting (ethograms) during two rainy and two dry periods. Besides, the abundance of nectarivorous bird species was estimated with line transects. Results showed that A. castaneiventris increases aggressiveness in the second dry season related to the two rainy seasons. In the rainy season, it depends on insects and in the dry season on flowers. Territory areas remain stable during the year, but in the driest season this species migrates. Seasonality affects hummingbird community abundance. Results are critical to protect not only A. castaneiventris' habitat in the Chicamocha canyon, but also its habitat in the places where it migrates, and to understand possible future changes in its range and its ability to adapt to the driest conditions as a consequence of global warming.*

International Congress Presentation, Canada

International Congress Presentation, China



- Poster:

Saving threatened dry forest biodiversity, Project Chicamocha, Colombia. XXIII International congress for conservation Biology. Beijing, China. 2009 (Fig. 7)
Abstract:

The Critically Endangered Niceforo´s Wren and Chestnut-bellied Hummingbird habit on remnant dry forests. To protect these birds and their habitat, our aim is to describe the ecological requirements and behavior for both species and to clarify their taxonomic status. We conducted 4 explorations in the Chicamocha Canyon, recording songs, describing behaviors, and characterizing their habitat. As a result, we obtained 13 new geographical records of T. nicefori and 9 of Amazilia castaneiventris.

T. nicefori is dependent of riparian forest between 700 and 2100 m.a.s.l. where couples defend territories of 1 hectare approximately. The populations were monitored by their vocal behavior. Both sexes produced coordinated vocal duets, and a variety of calls. In addition, discriminant analysis based on fine structural details of songs differentiates between two species of Thryothorus (T. nicefori and T. rufalbus). Chestnut-bellied Hummingbird defends territories with flowering trees between 850 and 2045 m.a.s.l., and we described a migration phenomenon during the stronger dry season on the Chicamocha Canyon. We hypothesized that the total of population migrates to another site during that season. In addition we found that human pressures from goat and cattle farming are destroying the habitat of both species.

In conclusion, our ecological and behavioral observations suggest that these species are restricted of the dry forest which implies the need to conserve the Chicamocha canyon. Besides, there are a great potential to use behavioral studies to determine the ecological and taxonomic status of bird species.

Publication of the Chicamocha Project achievements in ECOINDEX

Eco-Index® is a browser of ecological and conservation Project launched by the Rainforest Alliance in 2001 to provide quick and easy information for professionals interested in conservation projects. Eco-Index® is available in English and Spanish. In August 2010, the Chicamocha team submitted an article about the work done in dry forest biodiversity, which was accepted for publication (*http://www.eco-index.org/search/results.cfm?projectID=1429*). In this publication we obtained an award as the best monitoring and evaluation methodology during September 2010.


Eco-Index: Project Profile - Chicamocha Project: The Conservation of Two Critically Endangered Dry Forest Birds, Niceforo's Wren and the Chestnut-Bel...

Español

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Project Profile

Chicamocha Project: The Conservation of Two Critically Endangered Dry Forest Birds, Niceforo's Wren and the Chestnut-Bellied Hummingbird

Best monitoring & evaluation methodology
September 2010

Country or countries in which project was active: Colombia

Mapa | Satélite | Híbrido

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Migratory Species Pathway WHMSI

Eco-Index categories that best describe this project:

- Birds
- Conservation easements
- Environmental education
- Wildlife research

Date this survey was updated:

August 2010.

Responsible organization(s):

Fundación Conserva, Colombia.

Note: the responsible organization(s) support(s) graduate-level research projects and/or volunteers.

Project director(s):

Jorge Enrique Parra; Alexandra Delgadillo; Marcela Beltran.

Contact information:

Address: Calle 146 N 12-84 casa 3, Bogota, Colombia

Telephone: +57/480-5637

Email: jep33@bath.ac.uk

Fig. Nº 7. Chicamocha Project in EcoIndex

2.4 FUNDACION CONSERVA

After working together for more than 5 years, in August of 2009, the Chicamocha team decided to create a new non-governmental organization: the Fundacion Conserva, which is the result of the experiences and dreams of the Chicamocha Project members. Our main objective is to ensure the species and tropical ecosystems conservation providing research, environmental education and sustainable development to communities.

The Fundacion Conserva is composed of five members who, at present, are involved in the Chicamocha project as researchers, advisors and collaborators. All of them want to continue working on conservation in the Chicamocha region and in the future in other places of Colombia and South America.

Fundación conserva

Our institutional vision is to be an organization characterized by the excellence of their work, leading the implementation of conservation projects and scientific research, supporting students and young researchers, working with local communities and entities of public and private sectors as well as with international organizations.

Our specifics objectives are:

- Provide environmental services through counseling, consulting, research and training in: characterization of ecosystems, sustainable tourism and biodiversity, geographic information systems, biostatistics and environmental advertising.
- Involve local communities in developing projects that will be carried out by our foundation, transforming people in active agents and allow them be directly benefiting from the results of such projects.
- Work in environmental education projects targeting communities in general, in order to give them environmental education and raise awareness of the importance of conservation and sustainable management of the ecosystems.

Conservation actions:

During the short period of operation, The Fundacion Conserva has participated actively with other organizations in conservation projects which involve the Chicamocha canyon. Currently one of the members of the Fundacion Conserva is working in a project with other NGOs whose main objective is to create a communal reserve to protect a region of the Chicamocha canyon. During the first phase, this project is collecting basic information about regional biodiversity in order to define conservation objectives in the area. The Fundacion Conserva is participating in herpetological surveys and analyzing threats to local biodiversity.

Additionally we have already designed our institutional logo and we are currently designing a web page with the idea to have in a near future a bigger contact with potential sponsors and with people interested in biodiversity and conservation projects.

CONCLUSIONS AND RECOMMENDATIONS

Sharing with children, teachers and inhabitants of the municipality of Zapatoca, Santander during the second part of Chicamocha Project was one of the most rewarding experiences of our lives as researchers and professionals interested in conservation. In all the sites we visited, we found always a helping hand ready to support us, to listen and to make our job easier, so we know we have opened a promising opportunity to continue working towards the conservation of dry forest in this region of the Chicamocha Canyon.

The workshops in environmental education carried out in schools allowed us to make clear that knowledge of the local biodiversity by children is limited and it will be necessary to provide new opportunities to increase that knowledge and to generate awareness about the responsibility that communities have in the future of the ecosystems as well as about the opportunities that take care of environment offers to people. Nonetheless, a favorable aspect was that students were interested in learning and in enlarging their knowledge of the dry forest. Additionally, teachers were always receptive and grateful for our work and allowed us to share with their students very successful activities; Due to this, we are committed to not forget them and to continue working in this region, training teachers, providing guidance on environmental issues and promoting an educational environment that brings children, their teachers and other inhabitants to the environmental reality of this region, enabling them to appreciate and appropriate their natural resources so they can be guardians of nature and participants in realistic solutions for challenges they will face in the near future.

During our work we heard the concerns of Zapatoca residents regarding the water shortage that is occurring currently, and to extensive periods of drought and the lack of sustainability of goat rearing and agriculture activities in the region. Even though the creation of the first dry forest reserve in the Chicamocha Canyon has been a significant achievement reached with the invaluable help of the Foundation ProAves, much remains to be done and future work in the region should involve the development of sustainable economic alternatives to communities that allow us to conserve the dry forest and other ecosystems in the region and to protect the water supplies.

We know that our effort in Zapatoca is like a seed that must be cultivated for obtaining fruits, and we believe that the next phase of the Chicamocha Project should focus on working with the community generating proposals to allow the people of this region strengthen their environmental capacities and gradually move towards sustainable development in the region, becoming future conservation leaders in Colombia.

Taking in to account the results found during this phase, we believe that other important achievement reached during the Chicamocha project was the creation of the Fundacion Conserva, an organization that ratify the commitment of project members with conservation in Colombia and in particular with the dry forest biodiversity and that has the dream to become a leader organization in conservation.

CHAPTER THREE

Proyecto Chicamocha Colombia

RESEARCH AND MONITORING

GENERAL INTRODUCTION

The study of the biodiversity is fundamental for the development of conservation programmes and the sustainable use of the environmental resources. Therefore, the establishment of surveys and monitoring programmes of biodiversity have been one of the main targets in international agreements. Around the world ecosystems and their habitats are declining, and neither the causes nor the implications of these declines are well known. There are several gaps of information and degradation processes are currently in progress.

Dry ecosystems are the most threatened in the world (Etter, 1993, Primack, 2006). Desertification by agricultural practices and global warming are some of main causes of the rapid lost of these ecosystems. In Colombia, there is little information of the biodiversity of dry ecosystems and threats on these areas are constants. It is estimated that in Colombia remains the 1.5% of the original dry ecosystems (Conservation International 2007).

The Chicamocha canyon, in the central East-Andes of Colombia, is a dry ecosystem where little is known about its biodiversity. Hernandez-Camacho et al. (1992) suggested that the Chicamocha region is a centre of diversification due to its isolation from others dry ecosystems and because it has been found several species of fauna and flora endemics to the Chicamocha. However, there are few detailed studies of the biodiversity in the region. One remarkable work was about plants communities and structure in Chicamocha canyon by Sofia Albesiano (2003). Nevertheless, studies for other groups of organisms have not been well documented by researchers yet.

Therefore, here is presented different studies of biological organisms in the Chicamocha canyon. The objective is to increase the knowledge and provide information for encouraging best practices in the Chicamocha canyon.

3.1. AMAZILIA CASTANEIVENTRIS

(By Gerson Penuela, Ludy Archila, Marcela Beltran, & Jorge Parra)

Amazilia castaneiventris

INTRODUCTION

Amazilia castaneiventris or the Chestnut-bellied hummingbird is an endangered species endemic to dry forests of the Chicamocha valley in the Andes of Colombia (Hilty & Brown 1986, BirdLife international 2009). This species was rediscovered in 2003 after 25 years without documented records (Cortes et al 2004), its population is estimated in 3780 individuals (BirdLife international 2009) distributed from 320 to 2200 m of elevation (Parra et al. 2006). Like many other hummingbirds in the genus Amazilia (Stiles & Wolf 1970), A. Castaneiventris is a territorial species (Cortes 2006). It is commonly observed protecting its territory from intruders by vocal or visual displays and chasing (Cortes 2006, Stiles& Wolf 1970).

Some ecological studies in the municipality of Soata (Santander, Colombia) have shown that this species mainly occupy higher stratums of vegetation; and forages in the hedges composed by Tricanthera gigantea, its main feeding source (Chaves et al. 2004). Moreover, it has been found that besides of nectar, insects are important part of its diet since stomach contains have revealed clear preferences for coleopterans and dipterans (Cortes 2006). In spite of recent studies have recorded new populations of this species along the Chicamocha canyon (Parra et al. 2006), the chestnut-bellied hummingbird is still considered endangered (BirdLife international 2009).

A.castaneiventris lives in the tropical dry forest, one of the most endangered ecosystems on earth (Janzen 1988). In Colombia, dry forests are patchily distributed along the Caribbean coast, in the inter-Andean valleys, and in the eastern Andes (Etter 1993). The Chicamocha dry forest is part of the inter-Andean valleys located on the Eastern Cordillera of Colombia, between Santander and Boyacá departments. This ecosystem is characterized by having a marked weather change conditions during the year. There are two dry seasons between December-March, and June-August; and two rainy seasons between April-May, and September-October. Unfortunately, the Chicamocha canyon faces a continuous fragmentation caused by goats grazing and farming. It is estimated that only 1.5% of the original dry forest still remains (Etter 1993). Besides of these threats, the Chicamocha canyon may possibly be facing desertification problems caused by global warming. Primack (2006) defines dryland communities such as areas more prone to suffer desertification processes caused by temperature increases on earth. Studies have demonstrated that the chestnut-bellied hummingbird does not face the driest season in the Chicamocha canyon, reason why it does local migrations in this period (Cortes 2006). Therefore, it is crucial to have in mind that if this species avoid the driest seasons in the Chicamocha canyon, it is probable that increases on temperatures caused by global warming could put it in danger.

Despite that studies about some aspects of the ecology and behaviour of this species have been completed, there is not data about behavioural strategies of this species in extremely dry ecosystems. Behavioural studies could shed light on the ways which this species use to face higher temperatures, in order to think about alternatives to minimize possible impacts caused by global warming. In this project we studied the influence of seasonality on: relative abundance of the chestnut bellied hummingbird and its competitors, territoriality, and feeding behaviours in an extremely dry environment located in the Chicamocha canyon to 700 m of altitude.

OBJECTIVES

- 1. Monitory changes in relative abundance of A.castaneiventris and its competitors through the seasons in the natural reserve Cucarachero de Chicamocha.
- 2. Identify changes in the territory size for A. castaneiventris through the seasons.
- 3. Study the effect of seasonality on territorial and feeding behaviours of A. castaneiventris
- 4. Determine pollen loads and floral resources which compose the chestnut-bellied hummingbird's diet.

METHODS

- Study Area

This study was carried out in the Natural Reserve Cucarachero de Chicamocha (Zapatoca-Santander) during both rainy seasons (October 2008 and April 2009) and dry seasons (February 2009 and July 2009) (Fig. 3.1). This land represents one or the driest area in the Chicamocha canyon. The study was carried out at 700 m of altitude.

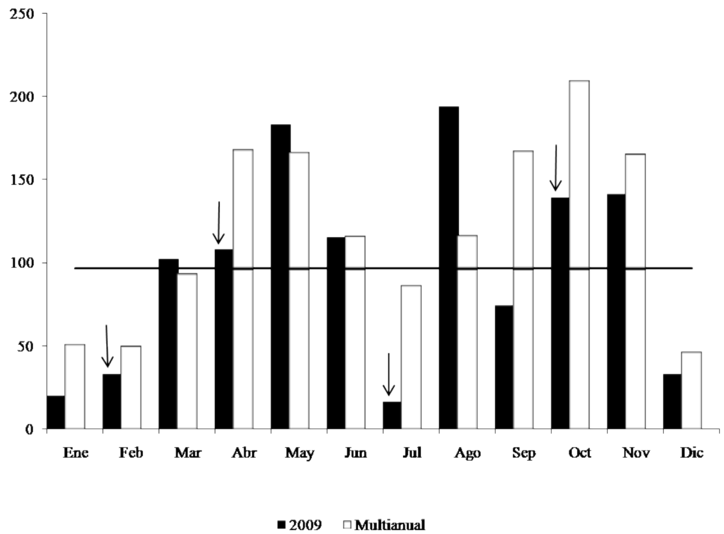


Figure 3.1. Variation of the precipitation at the Natural reserve Cucarachero de Chicamocha. Black line shows the mean of precipitation in 2009 (90mm). Black bars show precipitation per month in 2009. White bars indicate annual mean of precipitation during 10 years. Arrows indicate the sampling dates. Basic Data IDEAM 2009, La Fuente station.

- A. castaneiventris census and competitors monitoring

Census to determine the abundance of A. castaneiventris, and other hummingbirds were carried out through February, April and July. The census were performed using two lineal transects of 3 kilometres for each season. An observer walked along the transects from 6:00 to 10:00 hours recording hummingbird species, and number of individuals. To avoid recounted of individuals, transects were separated 500 m (Cárdenas et al. 2006).

- Territory size

Seven territories of A. castaneiventris were identified in the Natural reserve Cucarachero de Chicamocha. Each territory size was measured in October 2008, April, and July 2009 as following: A set of points locations where A. castaneiventris was observed doing any activity, were recorded using a GPS. Polygons were created using the recorded points, and the area of minimum convex polygon was estimated in each season for each territory (Beyer 2004). As many points locations as possible were recorded in each territory.

- Peak of Activity

It is defined as the time interval where the species is more active. In order to establish a timetable of behavioural observations, the peak of activity for A.castaneiventris was calculated. Before of taking behavioural data in each season, an individual of one territory selected by random, was observed during a whole day from 5:30 to 18:00 to record the period of higher activity.

- Territorial and feeding behaviours

We recorded the time allocated by each individual to execute territorial and feeding behaviours in April and July (Calviño 2006). We included in territorial behaviours the following activities: chasing, perching, and aggressive calls; and in feeding behaviours: insect consumption and nectar consumption (Table 3.1). Time was recorded during one hour for three days in each territory.

Table 3.1. Behaviours Description

Category	Behaviour	Description
Territorial Defence	Chasing	This behaviour is performed when other individuals intend to access to the resources inside of the territory. *A. cataneiventris* chases the intruders away. The result can be intraspecific or interspecific aggression.
	Perching	*A. castaneiventris* spends some time perched in a branch inside of its territory monitoring it.
	Aggressive calls	These calls are performed when an intruder enters inside the territory. Sometimes they are accompanied by chasing behaviours.
Feeding behaviours	Insects consumption	*A.castaneiventris* is observed suspended in the air catching insects. Generally, it flies from its perch, catches the insects, and returned to the perch again.
	Nectar consumption	*A.castaneiventris* is observed sucking at flowers.

- Flower resources and Pollen loads

The number of flowers consumed by A. castaneiventris was estimated in each territory on February, April, and July using the modified methodology proposed by Stang et al. (2006). To obtain pollen references of plant species from the territories, and compared them with hummingbird's pollen loads, samples of flowers were collected and carried to the Laboratory. Flowers were deposited in alcohol 70% and identified with taxonomic keys (Gentry 1993) in the herbarium at Universidad Pedagógica y Tecnológica de Colombia.

Individuals of each territory were captured to obtain pollen loads. Three mist nets were located near to the flower patches in each territory. Pollen samples were taken using jelly pieces following the methodology of Amaya (1991). To avoid pollen loss, samples were taken directly from the bird in the net. Jelly samples were located in plastic tubes to be carried to the Laboratory.

Pollen samples were observed using a microscope of 40x. Pollen grains were counted, separated by type, and photographed. The identification was made using the palinologycal atlas of Roubik & Moreno (1991) and the graphic Neotropical pollen key. Pollen collected was corroborated with pollen from the herbarium at the Instituto de Ciencias of Universidad Nacional de Colombia.

Statistic analysis

- Monitory of A. castaneiventris and its competitors

Encounter rate was obtained for all the species of hummingbirds, and it was compared graphically between seasons (Fig 3.2). The encounter rate is the total number of individuals divided by the total censed hours and multiplied by 10; it gives an estimative of expected species abundance in 10 sampled hours.

- Territory size

Territories were represented by polygons obtained by the GPS set of points (Fig.3.3). These polygons were generated through the complex polygon methodology, using the Hawths's tool in ARCGIS 9.2 (Beyer 2004). The area of minimum convex polygon was compared between seasons using Kruskall Wallis test (SPSS 17.0 2010) (Fig. 3.4).

- Territorial and feeding behaviours

Time budget for territorial and feeding behaviours was transformed in percentage of time calculated over one hour per season, and compared between seasons using Mann-whitney test (SPSS 17.0 2010) (Fig. 3.5).

- Flower resources and Pollen loads

The number of flowers per territory was compared between seasons using Kruscall wallis test (SPSS 17.0 2010) (Fig 3.6). Intensity use index (IU) was calculated to define the plant species more used by A.castaneiventris. IU is defined as the percentage of use of resource i x percentage of individuals using the resource (Amaya 1991). Values near to 1 indicate preferences for resource i. IU was compared graphically between plant species (Suarez & Torres 2009) (Fig. 3.10).

IU= Frequency of pollen i x Number of A.castaneiventris individuals using pollen i
Total Frequency of pollen   Total individuals of A.castaneiventris

A. castaneiventris and competitors monitoring

Encounter rate explains that A. castaneiventris was absent in the dry season in February when Chlorostilbon gibsoni was more abundant, and its abundance increased in the second dry season in July when the number of individuals of C. gibsoni decreased. Dorifera ludoviciae showed an increase in the encounter rate in the rainy season in April (Fig 3.2).

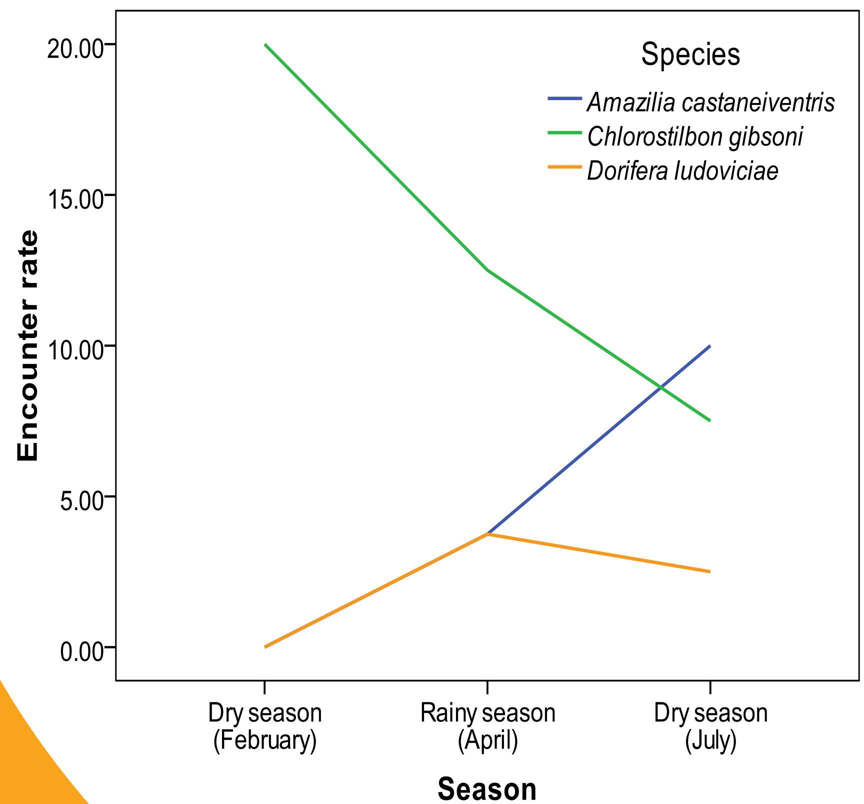


Figure 3.2. Encounter rate of A.castaneiventris and its competitors through the seasons

- Territory size

Results showed that territory size of A. castaneiventris remains constant during the seasons, except in February when A. castaneiventris is absent of the reserve (Kruscall wallis, X2=0.080,N=7, p=0.961) (Fig 3.4). In February, which is the driest season in the Chicamocha, this species migrates (Cortes 2006).

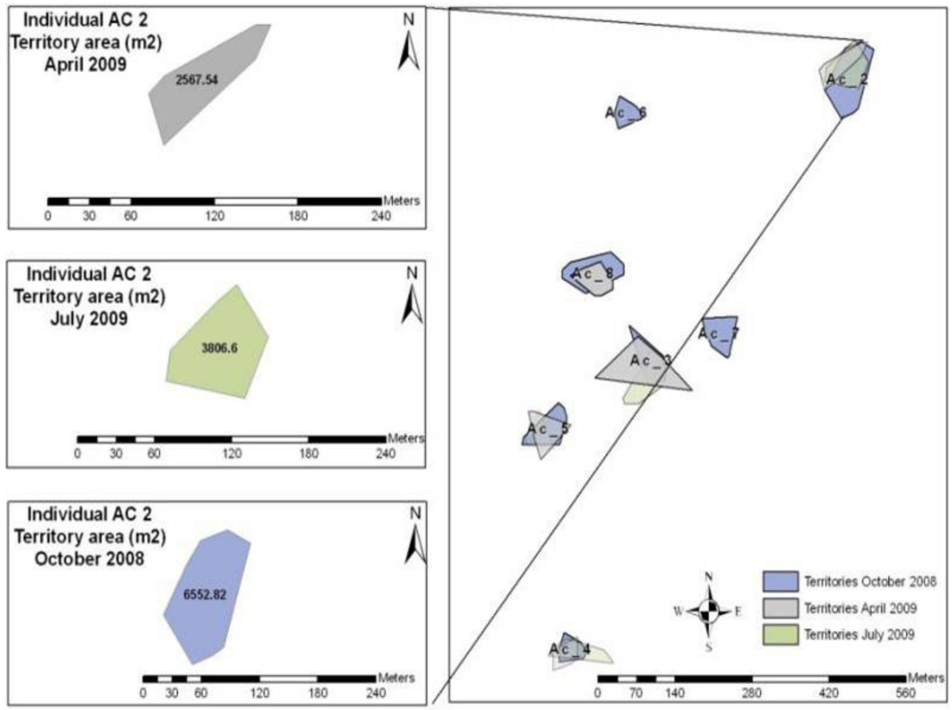


Figure 3.3. A. castaneiventris' territory size in different seasons (right). This is an example of a territory of the individual 2 through the seasons (left). Blue and gray colours represent the rainy season in October and April, and green colour represents the dry season in July.

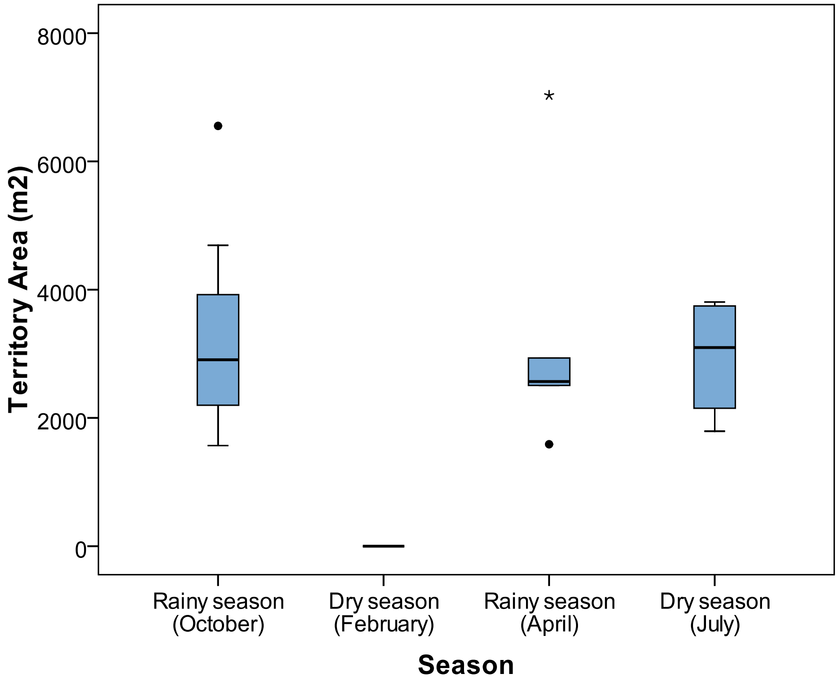


Figure 3.4. Territory size through the seasons.

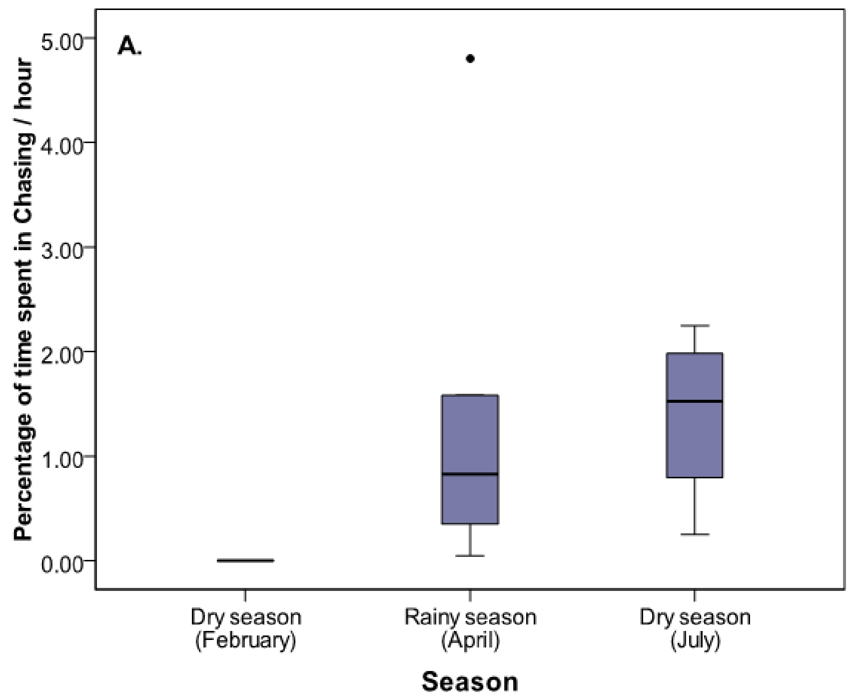
Peak of Activity

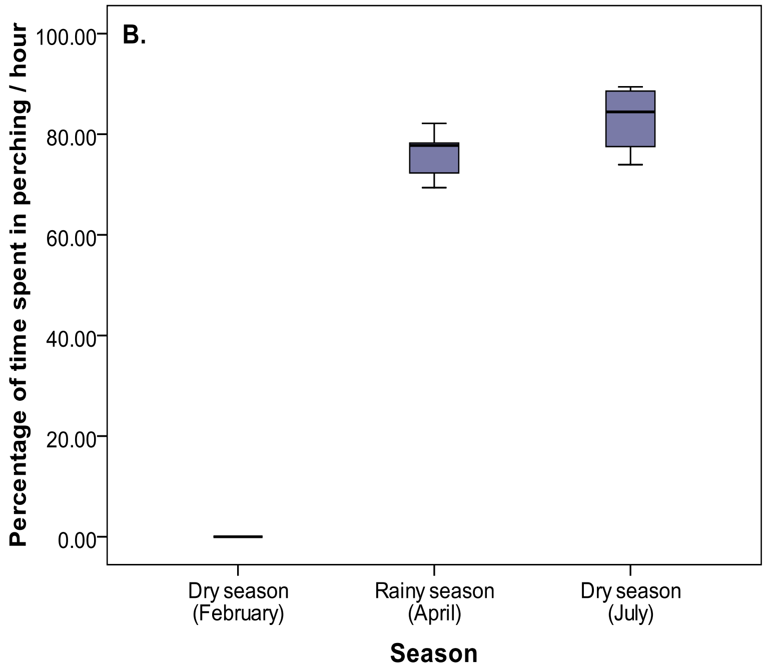
Results showed that the chestnut-bellied hummingbird was more active from 6:00 to 10:00 hours in April and July. This peak of activity is influenced by the weather, and the time where plants have a higher nectar production (Gutierrez et al. 2004). Behavioural observations were performed during this period.

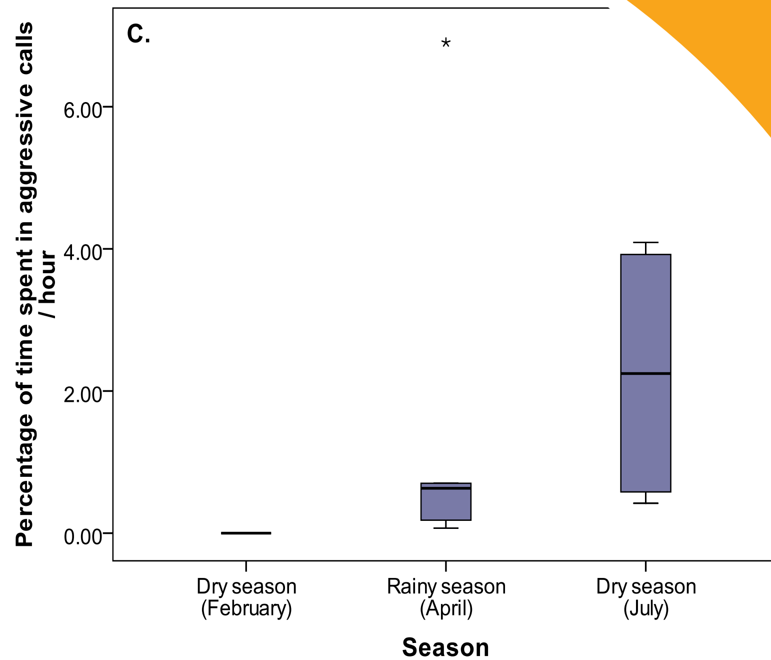
Territorial and feeding behaviours

There were no differences in the percentage of time spent by A. castaneiventris in chasing and perching between seasons (Mann-Whitney, t=0.140, N=5 p=0.893; t=-1.691, p=0,148 respectively) (Figs. 3.5A, B). Despite of there was no difference in the time spent by A. castaneiventris in performing aggressive calls, these calls tended to increase in July (Mann-Whitney, t=-1.88, N=5, p=0,151) (Fig. 3.5C).

Regard to the feeding behaviours, results revealed that in the rainy season A. castaneiventris increases insects consumption (Mann-Whitney, t=2.793, N=5, p=0,031) (Fig. 3.5D). On the other hand, there were no marked preferences by nectar between seasons, but there was a tendency to consume more nectar in the second dry season in July (Mann-Whitney, t=-1.022, N=5, p=0,381) (Fig. 3.5D).







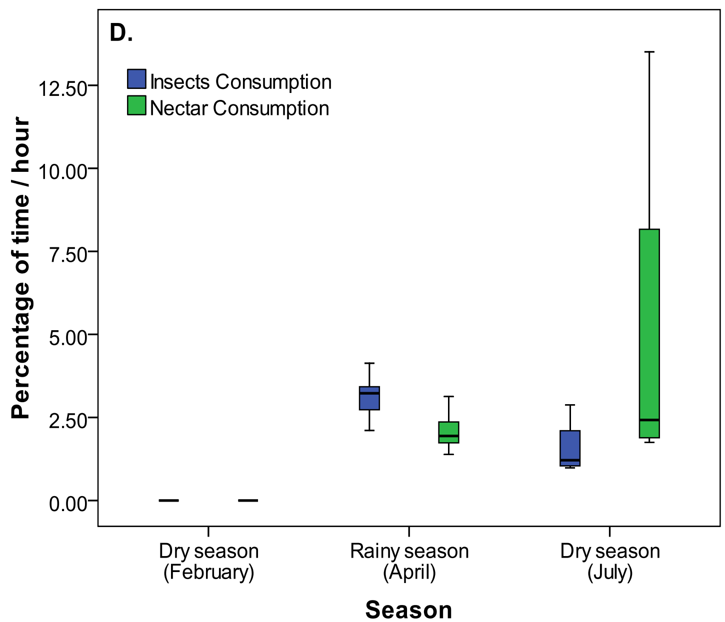


Figure 3.5. Time budget spent in territorial behaviours such as: A. Chasing, B. Perching, C. Aggressive calls; and D. Feeding.

Flower resources and Pollen loads

Flower density differed between seasons (Kruscall wallis, X2=41.2748, N=70, $p<0.05$). The results showed that the flower density is more abundant in the second dry season in July (Fig. 3.6).

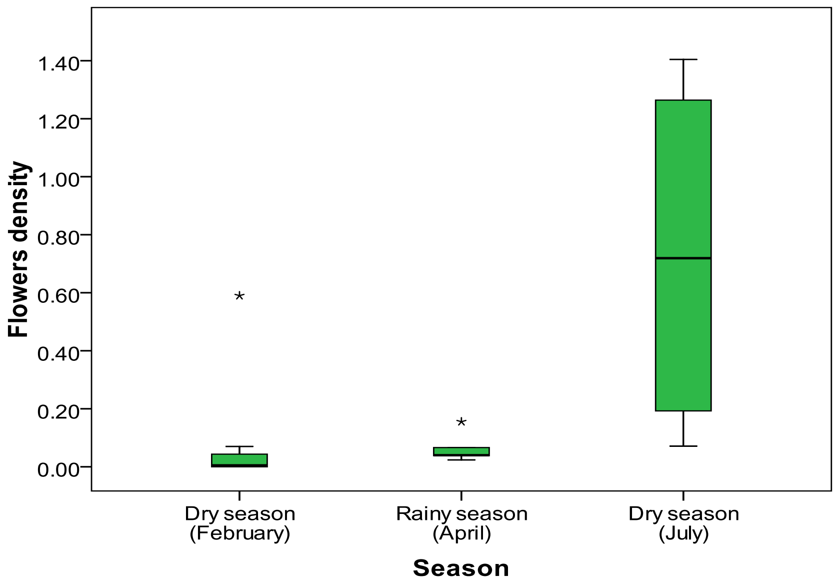


Figure 3.6. Flowers density through the seasons

In total 21 pollen types of nine families were collected, 18 types were identified to genus, one to species, and two were undetermined. Six types of pollen were collected from A. castaneiventris' territories for a reference collection (Fig. 3.7). Moreover, from A. castaneiventrs' body, 15 types were identified (Fig. 3.8). The most abundant pollen carried by A. castaneiventris belongs to both families Bromeliaceae and Apocynae, which have three and five species of plants at the reserve (Fig. 3.8).

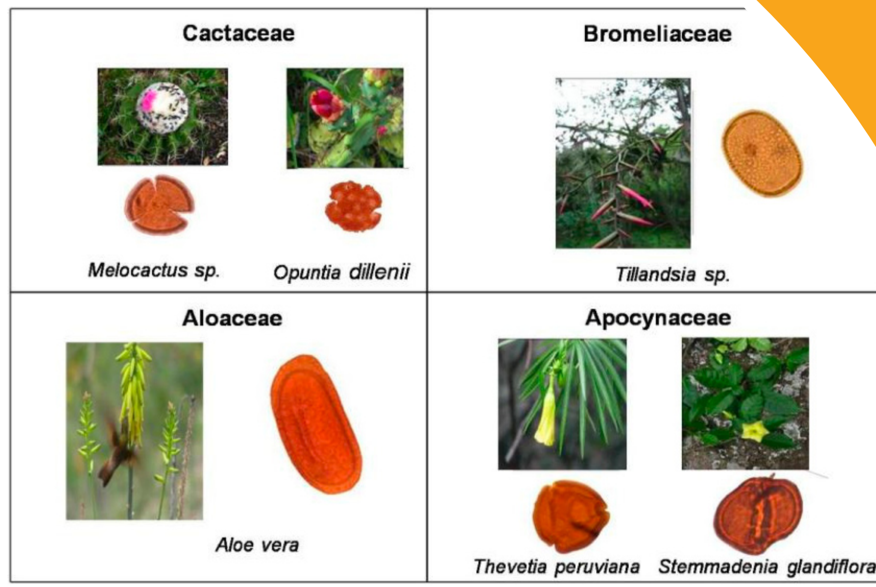


Figure 3.7. Samples of pollen for the reference collection.

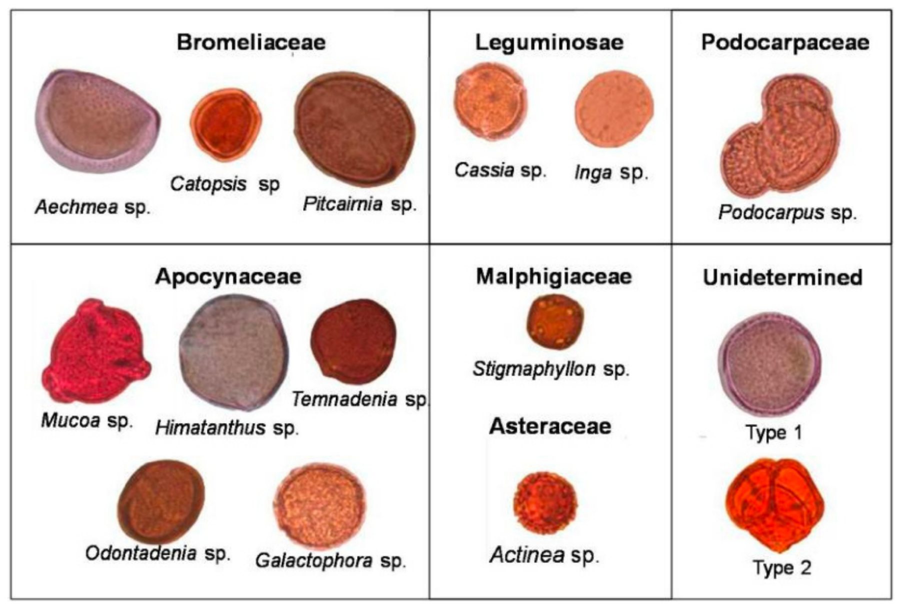


Figure 3.8. Pollen loads collected from A. castaneiventris' body

Despite of A. castaneiventris was observed sucking in the following species of plants: Tillandsia sp, Opuntia dillenii, Aloe vera, Opuntia sp. and Melocactus pescaderiensis; in its body only pollen of Tillandsia sp, Opuntia dillenii and Aloe vera were collected (Fig. 3.9). The rest of the pollen found in its body, and absent in the pollen references should have been collected in flowers outside of the territories, perhaps along the altitudinal gradient at the reserve.

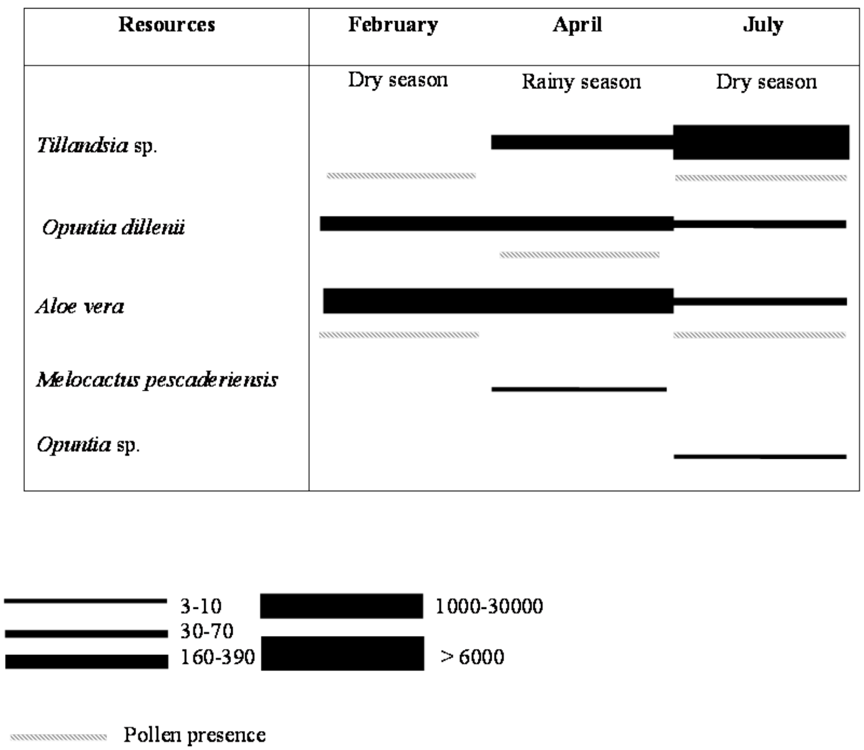


Figure 3.9. Variation of floral resources during the seasons. Black bars indicate the number of flowers found in the territories, and gray bars show pollen presence in body samples.

Even when A. castaneiventris showed a higher variation in the plants visited which could consider it as a generalist species; it also showed preferences by particular resources (Fig. 3.10). IU showed that the hummingbird prefers feeding on Tillandsia sp, Temmadenia sp and Actinea

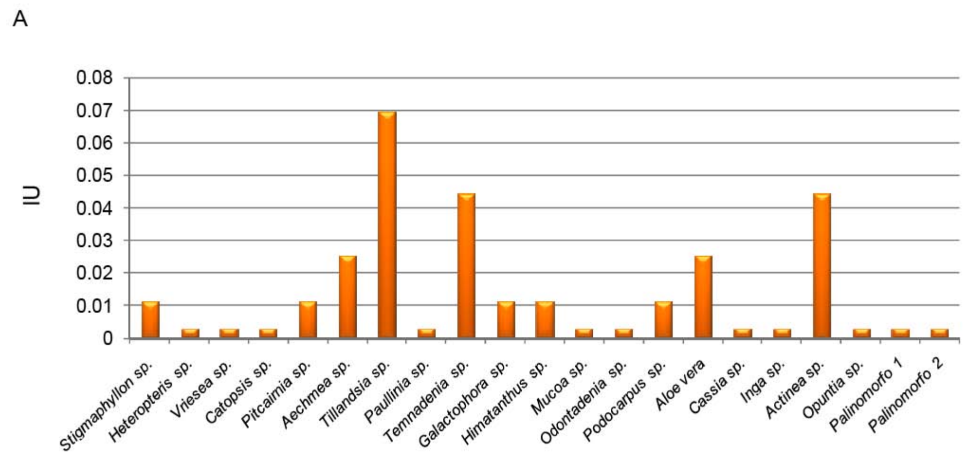


Figure 3.10. Intensity use index per plant species.

DISCUSSION

The purpose of this study was to establish the main behavioural strategies of A. castaneiventris to face extremely dry conditions. Therefore, to understand its strategies, here we analyse its competitors, territorial, and feeding behaviours.

A.castaneiventris and its main competitor C. gibsoni change their abundances during the year, A.castaneiventris does not face the driest season in the Natural reserve while C. gibsoni abound in this period (Fig.3.2). The strategy of the chestnut-bellied hummingbird of avoiding the driest period doing local migrations was also reported by (Cortes 2006). It is believed that it migrates in response to food scarcity (Montes 2006, Feinsignger 1976). Nevertheless, the routes and places of migrations are still unknown. Whether A. castaneiventris migrates in response to higher temperatures in the driest season, it is probable that global warming affects its migratory patterns, and its distribution which could become it more vulnerable.

On the other hand, C.gibsoni seems to cope better with the driest conditions perhaps because of its traplining behaviour (Snow & Snow 1980). This behaviour has advantages over territorial behaviours because in conditions of food scarcity, flowers are more disperse, and therefore mobile foraging behaviours could be a better strategy than taking care of nectar in a permanent place (Stiles 1978). Moreover, increases in abundance of A. castaneiventris over C. gibsoni in July, could be related with the peak on flowering in this season (Fig.3.6). In July, not only flower abundance increases, but also more resources are congregated in patches favouring territorial behaviours instead of traplining (Fig. 3.5C).

We expected to find changes in territory size during the year, and we expected these changes were influenced by flowering (Stiles & Wolf 1970). It is known that flowering varies with seasonality, and territory size varies with resources abundance (Stiles & Wolf 1970). However, results did not show this trend. Even when there was a peak of flowering in July (Fig.3.6), there was not an increase in territory sizes in this month (Fig.3.4). It is known that the function of territories in many cases is not only to protect food; but also other resources which maximize reproduction such as mates, nesting areas or mating places (Brown 1964). It is likely that A.castaneiventris protects other resources different from flowers which perhaps do not change dramatically with seasonality. Individuals of A. castaneiventris have been observed occupying the same territories since 2004 in the natural reserve and after the driest season, they seem to return to the same territories (Beltran pers. com). Perhaps, these territories besides of providing nectar, offer other resources such as insects, nesting areas, breeding spaces, roosting spots or perches. Moreover, territory size varies considerably between individuals especially in October and July (Fig.3.4). This variation could be related with the maximization of energy that an individual achieves by defending a territory. It is expected that individuals assess when a territory size is optimal and adjust it into the most favourable dimension (Carpenter et al 1983). Perhaps, bigger territories allow protection of more spread resources, while smaller territories facilitate protection of more congregated.

A.castaneiventris is often observed repelling intruders by chasing or vocal displays. Increases of aggressive calls in the second dry season might be related with a peak in flowering, which makes the hummingbird more alerted against intruders (Fig.3.6, Fig.3.5C). Also, the peak in flowering in July seems to be influencing the raise of nectar consumption by A. castaneiventris (Fig.3.5D).On the other hand, in the rainy season (April), the species increases insect consumption. Many studies demonstrate that insects rise with rains, which broad hunting opportunities for the chestnut bellied hummingbird (Montes 2006, Bohorquez & Montoya 2004). However, increases in insect consumption coincide with the nesting period of A. castaneiventris. It is known that some birds increase protein consumption for the egg laying (Robbins 1983). At the end of April, an individual of the Chestnut-bellied hummingbird was observed building a nest in a Prosopis sp. tree. It was located at 3m high and under leaves which cover it from rains. The nest was composed by spider's silk, cotton, lichens, and goat's hairs. The construction lasts 7 days, and the incubation 17 days approximately. There are not records of the chicks, because the nest was depredated after hatching.

Pollen loads showed that A. castaneiventris visits a varied number of plants, which point out this species as generalist. In contrast, studies carried out by Cortes et al. (2004) in Soata (Boyaca) reported strong preferences of A. castaneiventris for the plant Tricanthera gigantea. To adopt a generalist strategy warrants the obtaining of food in a changing environment (Feinsinger et al. 1978, Gutiérrez & Rojas 2001). Some species of plants used by the hummingbird such as Opuntia dillenii and Aloe vera provide nectar during most part of the year (Fig.3.9), but A. castaneiventris does consume them in the rainy season. It is likely that even when the chestnut bellied hummingbird showed a generalist feeding behaviour, it prefers some plants such as Tillandsia sp, Catopsis sp, Pitcairnia sp (Fig. 3.10). This result contrasts with results found in Soata (Boyaca) by Cortes (2006), who reports A. castaneiventris as a specialist species strongly related with the plant Tricanthera gigantea. Possibly, A. castaneiventris adopt a generalist feeding behaviour in the Natural reserve as a response to the drastic weather conditions, which are not similar in Soata. A generalist feeding strategy offers advantages over specialist strategies in a changing ecosystem, because generalists can face food scarcity easier that specialists ones.

Even when A. castaneiventris is a territorial species, the pollen loads demonstrated that it does not only consumes nectar from plants inside its territory, but it also forages in different areas to broad its diet (Gutierrez & Rojas 2001). The natural reserve goes from 300m to 2100m of altitude which means that A. castaneiventris could travel looking for additional resources.

CONCLUSION AND RECOMMENDATIONS

There were changes in the abundance of the chestnut-bellied hummingbird during the year, and these changes are related with the abundance of C. gibsoni. It is clear that when A.castaniventris increases, C. gibsoni is scarce. Contrary, when A. castaneiventris migrates, C. gibsoni increases dramatically.

It is important to establish conservation actions for A.castaneiventris focused not only on protecting the areas in the chicamocha canyon, where it spends most of its life cycle, but also on identifying the migratory routes and sites of migration, and protect them. Therefore, it is urgent to start a long term monitory programme along the Chicamocha canyon using adequate and effective ways of marking.

A.castaneiventris adopts different behavioural strategies to face changes generated by seasonality. It migrates in the driest season, increases its aggressiveness when flowers abound, and consume more insects in the rainy season.

A.castaneiventris could be affected by the Global warming because its habitat is prone to be affected by temperature increases. It is possible that changes in its population trends, its range and flowering pattern are occurring. Therefore, in order to look for alternatives to protect this species, more studies on global warming and its effects need to be carried out.

The chestnut-bellied hummingbird showed a generalist feeding behaviour, although it prefers some species of plant such as: Tillandsia sp, Catopsis sp, Pitcairnia sp. This feeding strategy offers advantages over specialist strategies in a changing ecosystem, because generalists can face food scarcity easier that specialists ones.

3.2. THRYOTHORUS NICEFORI

3.2.1. USING FLUCTUATING ASYMMETRY FOR MONITORING ECOLOGICAL STRESS FACTORS IN THE HABITAT OF THE CRITICALLY ENDANGERED NICEFORO'S WREN

(By Alexandra Delgadillo, Antonio Quiñones, Valentina Gómez, Alejandro Lozano, Marcela Beltrán & Jorge Parra).

Thryothorus nicefori

INTRODUCTION

In the dry forest of the Chicamocha Canyon, wildlife populations are facing several sources of stress regarding to human activities; Ecosystems have been deforested by goat and cattle farming (Parra et al., 2006), and as a result, an increase in habitat loss and fragmentation of forests is been leading. Besides modifying the abiotic conditions experienced by organisms, these factors affect the connectivity of habitats aside from biotic resources that they depend upon (Fahrig, 2003). This could the case of Niceforo's wren (Thryothorus nicefori), an endemic species from the Chicamocha canyon, critically endangered.

One possibility to assess the consequences of habitat disturbance on health of populations and communities is through individuals' developmental stability which is defined as the capacity of an individual to buffer its development against random errors (Palmer and Strobeck, 1986). It is related to the ability of an organism to resist perturbations during its development and growth process (Moller and Swaddle, 1997). Small perturbations during development are corrected by stability mechanisms, reducing the phenotypic variation of traits that could be expressed within a population (Anciães & Marini, 2000). In a without stress environment, bilaterally symmetric traits are morphometrically identical. Nonetheless, in nature it is not possible as there will always be elements of randomness in an organism's development, resulting in asymmetry (Moller and Swaddle, 1997). Under stress conditions, developmental pathways that buffer against the expression of asymmetric characters may break down, and the expression of discrepancies between right and left sides of bilaterally symmetric characters can be evident. This phenomenon is known as fluctuating asymmetries (Van Valen, 1962). The greater stressful conditions the less energy will be available to buffer developmental process, and increasing levels of asymmetry can be expected (Parsons, 1992).

Due to this, fluctuating asymmetry is a common index of developmental instability (Anciães & Marini, 2000). Hence, individual asymmetry can be used as a measure of an organism's ability to buffer its development against both genetic and environmental perturbations, providing a sensitive monitors of such stresses consequences before detrimental impacts occur in the population (Clarke 1995).

In the case of T nicefori and other birds inhabiting dry forest, some of the consequences of habitat loss and fragmentation can be linked to 1) phenotypic changes related with developmental instability (Crooks et al., 2001; Anciães & Marini, 2000), and 2) to the fall in the population's size that in extreme cases can conduce to extinction. For T nicefori the extinction process is going on, and it is feasible that consequences of habitat quality can be reflected additionally in developmental instability. Due to the fact that T nicefori is a species with very few individuals per population, this study focused on the habitat characteristics found in five territories where living just one or two individuals of this species. In this case the objective was to evaluate if fluctuating asymmetry, at community, foraging guild and other species level, reflects the health status of communities tackle the same stressful conditions than T nicefori.

OBJECTIVES

Working with birds captured in five different fragments of forest, where T nicefori territories were located, the aims of this research were:

- 1. Characterize the habitat conditions of each forest fragment in terms of vegetation structure, insect community and soil cover and evaluate the possible differences among places.
- 2. Determine if there are differences among places in fluctuating asymmetry indexes.
- 3. Evaluate if there was a correlation among habitat characteristics and the three levels of fluctuating asymmetry calculated (community, foraging guild and species).

METHODS

- Study sites

This study was carried out in five municipalities of Santander, during July and August 2009. The places are located in the Chicamocha canyon with the presence of one T nicefori territory in each one (Table 3.2).

Table 3.2. Geographic coordinates of the study sites.

Place	Municipality	Geographic coordinates	Elevation range (m)	Number of *T nicefori* individuals observed
El Guasimo	Zapatoca	N6.80579 W73.22544	1098-1159	2
Milton	Zapatoca	N6.80251 W73.28691	1589-1641	2
San Gil	San Gil	N6.54989 W73.12311	1181-1207	2
Macaregua	Curiti	N6.66085 W73.10985	1535-1564	1
Butaregua	Barichara	N 6.71581 W 73.20545	962-994	2

- Habitat characterization and bird captures

At each site, the vegetation was sampled using transects of 400m2.The transects were of variable length (due to difficulties of the terrain) and its width was 2m. Within each transect it were recorded all individuals with circumference at breast height ≥ 3.1cm (Diameter at Breast Height DBH ≥ 1cm), and approximate height was measured for each one, including lianas. Besides, species accumulation curves were plotted to see if the sampling effort and methodology were appropriate.

Specimens of all plant morphotypes were collected in the field, fixed with ethanol, and deposited in the Herbarium of the Los Andes University. The taxonomic identification was carried until the lowest taxonomic level possible using the classification system APGIII Angiosperm Phylogeny Website. From these data diversity indexes were calculated.

Additionally, for the five places, 50 plots of 1m2 were evaluated for sampling leaf litter. A fixed frame of PVC pipes of 1m2 was thrown on the ground near the places where vegetation transects were made. Once the quadrant was thrown, it was estimated the leaf litter depth using a rule set perpendicular to the ground. Then, there were taken three measures of leaf litter depth per plot. After that, the plot was halved creating 4 quadrants corresponding to 25% of the area of the plot, and for each quadrant was calculated the percentage of soil cover of leaf litter, rocks and the bared soil.

Using the same 50 plots, after taking the soil measurements, the leaf litter was completely removed and all insects found were collected. Specimens were taxonomically identified until the lowest level possible. Diversity and equitability index were calculated from these data.

Birds were captured by passive mist-netting (no use of tape luring or artificial feeders) in fragments. Each site was evaluated in a four day periods opening four mist-nets from 06.00 h to 17.00 h and checked each 30 minutes. 162 birds belonging to 36 different species were captured. Every captured bird was identified to species, weighed, measured to estimate asymmetry and marked. The main diet of each species was classified as: insectivorous, frugivorous, omnivorous, granivorous (Sick 1993).

- Morphological measurements

After initial evaluation, three traits were selected for further scrutiny: length of tarsus, length of wing and length of hallux. These traits show high measurement repeatability, and have been previously used in field studies of trait asymmetry (Lens et al., 1999; Brown & Brown, 2002). Tarsus length was measured from the notch on the back of the intertarsal joint to the lower edge of the last complete scale before the toes diverge (Lens et al. 1999). To be able to statistically quantify measurement error, three repeated measurements of each trait were made on each specimen. Measurements were taken in the field to the nearest 0.01 mm using sliding calipers and wing ruler. To reduce bias, measurements were alternated between traits on each side of a specimen.

- Fluctuating asymmetry analysis

Repeated measurements on left and right sides were taken to distinguish the within-side variation from true asymmetry. Only one researcher took all the measurements. To determine the fluctuating asymmetry for each trait we followed the methodology proposed by Pomory, 1997 and by Palmer and Strobeck, 1986.

The fluctuating asymmetry of each character was initially calculated for each individual (FAi) as the unsigned values of:

$$FAi = (R - L)/ [(R + L)/2]$$

Where R = mean of right side measurements, and L = mean of the left side measurements.

The communities were analyzed using three different procedures. In the first community analysis, all species present in each area were considered. In the second analysis, comparisons within foraging guild among places were performed and in the third analysis only species present in all sites were considered, to avoid the effect of different species in the results.

The parameter of fluctuating asymmetry for each community (FAc) was estimated for each characteristic as the variance of the fluctuating asymmetry estimate described in the previous equation:

$$FAc= V(R- L)/[R+L)/2].$$

The index based on the variance of relative fluctuating asymmetry is recommended because it is sensitive to small fluctuating asymmetry variations in cases where there is size variation in the characteristic and when directional asymmetry and anti-symmetry are absent (Palmer & Strobeck 1986).

The parameter of fluctuating asymmetry for each foraging guild (FAg) was estimated for each trait as the variance of the fluctuating asymmetry estimate described in the previous equation:

$$FAg= V(R- L)/[R+L)/2].$$

- Statistical analysis

Comparisons among the five places in habitat characteristics were conducted through ANOVA. If necessary, Tukey test for unequal sample size were used to detect differences among samples.

Differences among places in fluctuating asymmetry values were evaluated through ANOVA. If necessary, Tukey test for unequal sample size were used to detect differences among samples.

The relationship between fluctuating asymmetry (in each trait) and forest characteristics was achieved through Pearson correlations. These analyses were performed in three levels: At community, foraging guild and species level. In the case of species level there were only taking in to account the species present in all places.

RESULTS

There were differences among places in terms of leaf litter cover, rocks cover and leaf litter depth (Table 3.3). Macaregua had significantly more leaf litter cover than Guasimo ($p= 0.028$) and than Butaregua ($p=0.021$). Guasimo had higher levels of rock cover than San Gil ($p<0.001$) and than Macaregua ($p=0.005$). San Gil had significantly less depth of leaf litter than Milton ($p=0.025$) and than Butaregua ($p= 0,004$).

Table 3.3. Comparisons among places in the values of soil cover variables. The significance of the ANOVA test is showed below.

Place	% of leaf litter cover	% of rocks cover	% of bare soil	Leaf litter depth
Guasimo	76.30±27.21	18.20±24.96	5.50±17.93	3.04±1.83
Milton	86.90±19.19	9.90±18.11	3.20±8.44	2.56±1.38
San Gil	87.40±22.46	1.60±5.85	10.60±21.61	1.66±0.80
Macaregua	90.20± 18.10	8.74± 1.19	5.10±15.53	1.84±0.89
Butaregua	76.50±25.46	14±22.7	9.50±19.08	2.48±1.72
Significance (P)	**0.004**	**P< 0.001**	0.057	**P< 0.001**

In terms of vegetation the five places were heterogeneous in its characteristics (Table 3.4). On the one hand, Guasimo showed the highest diversity of plants followed by San Gil, Macaregua and Butaregua respectively, while Milton had the lowest plant diversity. On the other hand, whereas Milton, San Gil and Macaregua presented the highest woody plant densities, Guasimo and Butaregua showed the lowest densities. In the case of the basal area of trees, it was highest in Macaregua than in the other places, followed by Butaregua. San Gil and Guasimo presented intermediate basal areas of trees and Milton had the lowest values. Nonetheless, in all places leaf litter cover were higher than 75% (Table 1).

Regarding to lianas composition, the diversity of lianas was low in Milton, intermediate in Butaregua and San Gil, and high in Guasimo and Macaregua. Besides, all places had similar values of lianas density, except for Guasimo where the lianas density was highest. At last, the basal area of lianas was higher in Butaregua than in the other places, followed by Guasimo and Macaregua with intermediate values, while Milton and San Gil had the lowest area of lianas.

Table 3.4. Comparisons among places in vegetation characteristics.

Variable	Guasimo	Milton	San Gil	Macaregua	Butaregua
Plants diversity index	42	25	34	34	29
Woody plants density	127	229	241	251	135
Basal area of trees (m^2)	125,88	78,21	106,27	226,26	200,87
Lianas diversity index	10	1	4	7	3
Lianas density	22	13	14	15	12
Basal area of lianas (m^2)	4,26	0,43	0,85	2,14	8,83

In each place, insect's diversity and equitability were evaluated. Results indicate that places are very similar in these characteristic except for San Gil where the insect diversity and equitability were lower (Table 3.5).

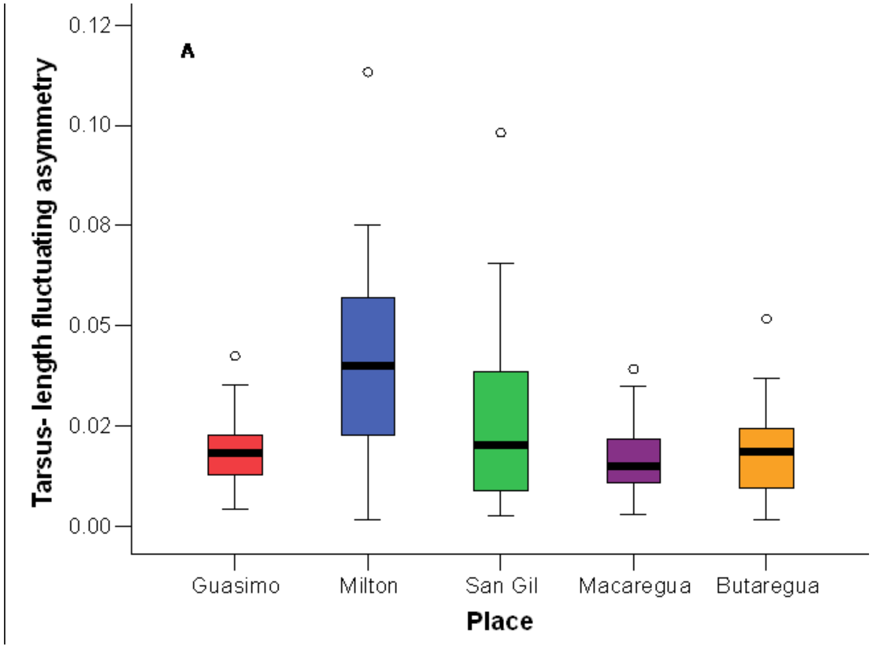
Table 3.5. Insect diversity and equitability in the study places.

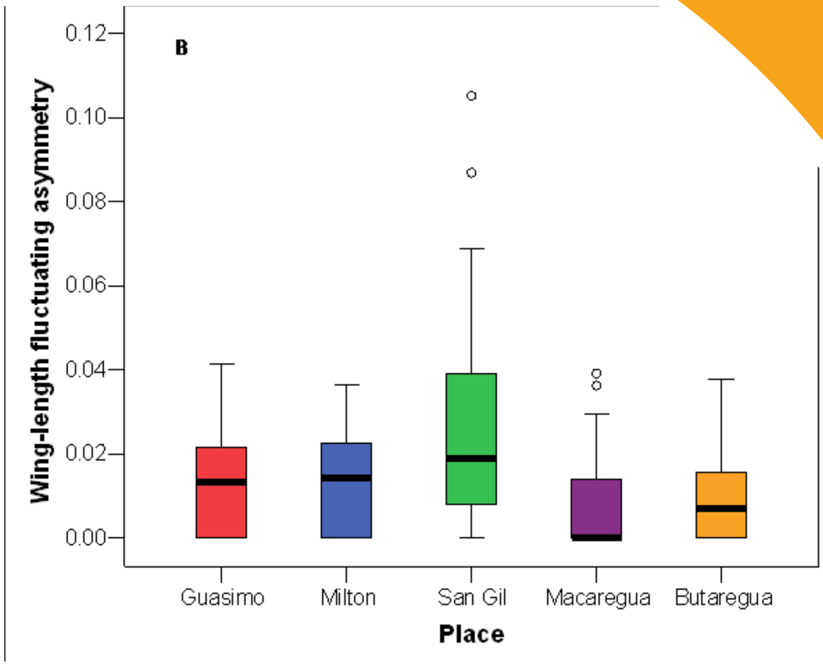
Variable	Guasimo	Milton	San Gil	Macaregua	Butaregua
Shannon diversity index of insects	1.84	1.55	0.63	1.62	1.52
Equitability J index of insects	5.57	6.43	3.57	4.86	3.14

The fluctuating asymmetry analysis (Table 3.6) shows that hallux had the highest values of asymmetry while wing length had the lowest. Additionally, there were differences among places in tarsus and wing-length fluctuating asymmetries (Table 3.6). In the tarsus analysis (Fig. 3.11A), individuals from Milton presented larger asymmetries than individuals from Guasimo (P= 0.036), Macaregua (P= 0.001) and Butaregua (P= 0.007), further, wing-length asymmetries were larger in San Gil than in Macaregua (P<0.001) and Butaregua (P= 0.011), (Fig. 3.11B). There weren't differences among places in hallux fluctuating asymmetries (Fig. 3.11C).

Table 3.6. Differences in fluctuating asymmetry (FA) among study sites.

Place	FA tarsus	FA hallux	FA Wing-length
Guasimo	0.025±0.020	0.048±0.032	0.017±0.020
Milton	0.043±0.026	0.068±0.061	0.018±0.026
San Gil	0.026±0.018	0.061±0.041	0.028±0.029
Macaregua	0.019±0.014	0.050±0.035	0.006±0.009
Butaregua	0.021± 0.016	0.041±0.023	0.011±0.016
Significance (P)	**0.003**	0.102	**P< 0.001**





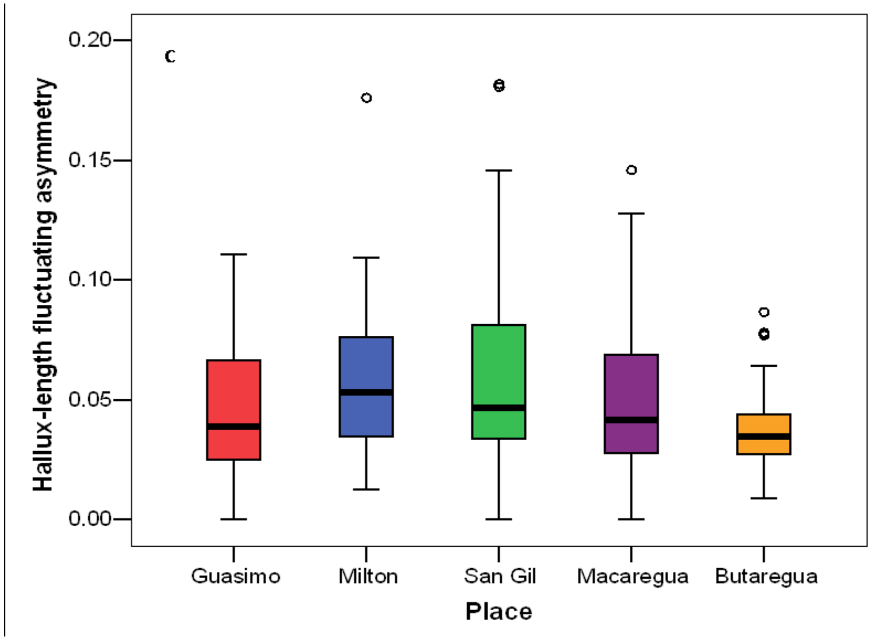


Fig. 3.11. Differences among places in values of fluctuating asymmetries of: A) Tarsus length, B) Wing-length, C) Hallux length.

At community level, there was a significant and negative correlation between the basal area of lianas and the values of hallux fluctuating asymmetry (P= 0.005, Pearson correlation coefficient= -0.975; Fig. 3.12). The other habitat characteristics weren't correlated with fluctuating asymmetry values.

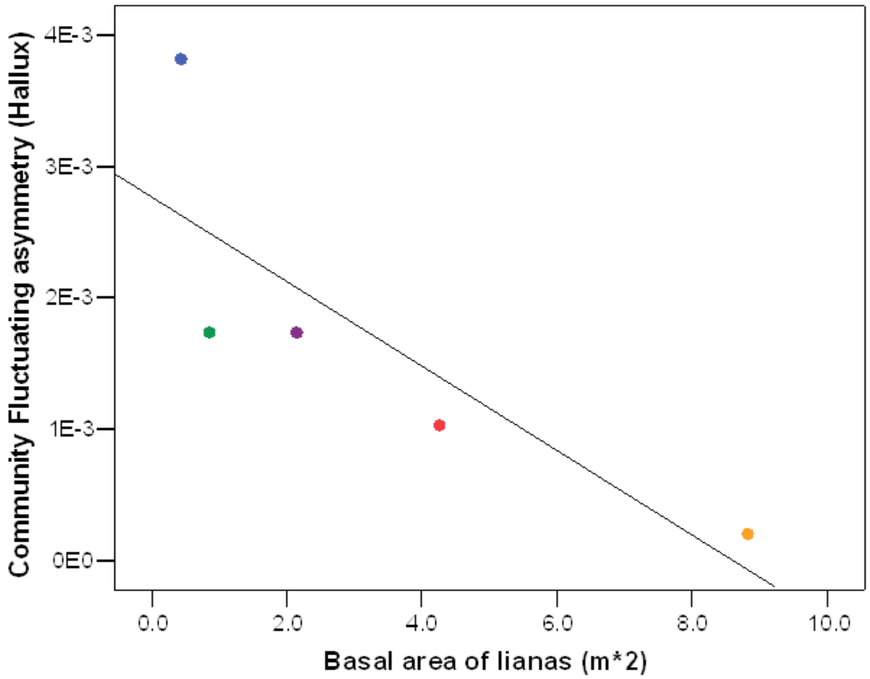
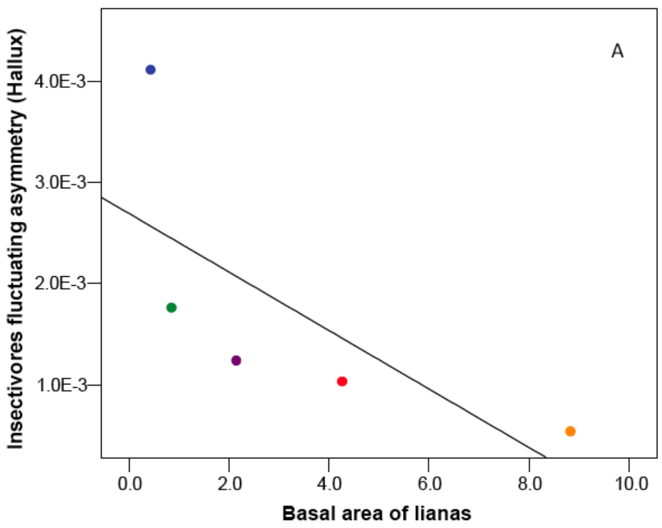


Figure 3.12. Correlation between hallux fluctuating asymmetry at community level, and basal area of lianas. Each color corresponds with a site: Guasimo: red, Milton: blue, San Gil: green; Macaregua: purple, Butaregua: orange.

At foraging guild level, when evaluating omnivorous, frugivorous and granivorous, there weren't correlation between habitat variables and fluctuating asymmetry values of tarsus, wing length or hallux. Nevertheless, in insectivorous, hallux fluctuating asymmetry was correlated negatively with basal area of lianas (P<0.001, Pearson correlation coefficient= -0.998; Fig. 3.13A), and wing-length fluctuating asymmetry correlated negatively with basal area of woody trees (P= 0.020, Pearson correlation coefficient= -0.900; Fig. 3.13B).



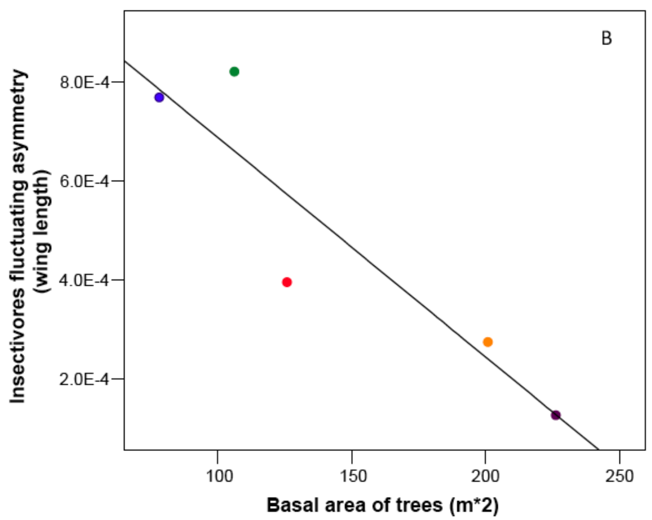
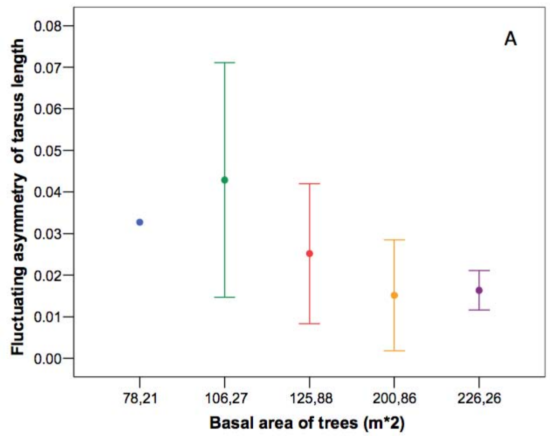


Figure 3.13.Fluctuating asymmetry at foraging guild level: A) correlation between hallux fluctuating asymmetry and basal area of lianas, B) correlation between wing-length fluctuating asymmetry and basal area of lianas. Each color corresponds with a site: Guasimo: red, Milton: blue, San Gil: green; Macaregua: purple, Butaregua: orange.

Only two species occur in the five places. There were Thryothorus nicerori (with one or two individuals per site) and Basileuterus rufifrons (with 4 to 10 individuals per site), both of them insectivorous. With each species separately, correlations between mean fluctuating asymmetry values and habitat characteristics were performed. There weren't correlations between T nicefori fluctuating asymmetry values and any of the variables evaluated. However, in the case of B rufifrons it was a marginal negative correlation between the basal area of trees and the fluctuating asymmetry of tarsus (P= 0.042, Pearson correlation coefficient= -0.530; Fig 3.14A). Additionally, there was a negative correlation between the leaf litter depth and fluctuating asymmetry of hallux (P= 0.022, Pearson correlation coefficient= -0.587; Fig 3.14B).



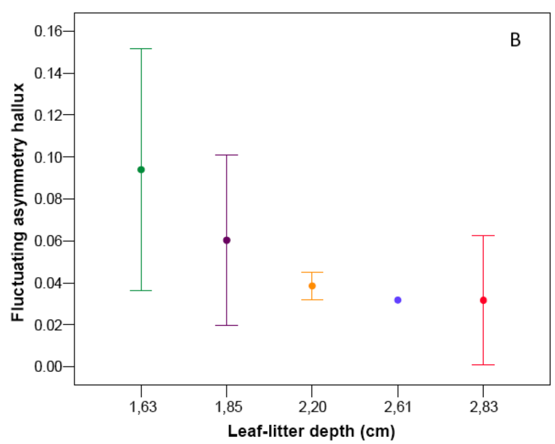


Figure 3.14.Fluctuating asymmetry at Basileuterus rufifrons level: A) correlation between tarsus fluctuating asymmetry and basal area of lianas, B) correlation between hallux fluctuating asymmetry and leaf litter depth. Each color corresponds with a site: Guasimo: red, Milton: blue, San Gil: green; Macaregua: purple, Butaregua: orange.

DISCUSSION

One of the major causes of species extinctions is the habitat disturbance which may interrupt gene flow, affect population size and promote inbreeding (Wayne et al. 1992). Due to this, it has been an increase in the need for methods to monitor quality of wildlife populations and fluctuating asymmetry is a suitable possibility. The present study demonstrated differences in quality and composition among five forest fragments which are the habitat of the threatened species Thryothorus nicefori. Furthermore, there was a difference among places in fluctuating asymmetry in birds and a negative correlation between some forest fragment characteristics and fluctuating asymmetry.

At community level, hallux asymmetry correlated negatively with basal area of lianas (Fig 3.12); at foraging guild level, in insectivores, the hallux asymmetry correlated negatively with the basal area of lianas (Fig 3.13 A) and the wing length correlated negatively with the basal area of trees (Fig 3.13B). Finally, at species level (in Basileuterus rufifrons) there were negative correlations between tarsus asymmetry and the basal area of trees (Fig 3.14A) and between hallux asymmetry and leaf litter depth (Fig 3.15). In all cases the highest levels of fluctuating asymmetry was found in the forest fragment with the lowest values of the characteristic implicated. These results suggest that as a consequence of habitat quality changes, bird communities exhibit phenotypical responses expressed as asymmetry. Furthermore, these results are detected in different levels of the community.

According to previous researches (see Rourke, 2004 for a review), the rise of fluctuating asymmetry in morphological characters occurs under genetic stress (hybridization, high inbreeding, small population size) or environmental stress (contamination, parasitism, low food availability) and the effects of both can be cumulative (Parsons 1992). Whatever the source of the asymmetry is, these results have conservation implications because if there are environmental stressors affecting developmental processes at level of individuals, these individuals could be implied in ecological process occurring at the level of communities (Callaway et. al., 2003; Werner & Peacor, 2003). It means that environment can influence developmental process producing variable phenotypes and as a result it can influence intra and interspecific interactions, thus altering community dynamics (Cuervo & Restrepo, 2007).

It has been reported that fluctuating asymmetry levels in birds from fragmented forests may have been increased due to higher environmental stress. In this way habitat change has been associated with an increase in pressures from predators, competitors, parasites and disease (Rolstad 1991) as well as decrease in food supplies, shelter and nest site availability (Rappole & Morton 1985; Bierregaard & Lovejoy 1989). Hence, our research supports results found by other studies in which the level of forest degradation determines fluctuating symmetry alteration, demonstrating the environmental basis of the stress affecting fluctuating asymmetry (Lens et al. 1999; Anciães & Marini, 2000).

Additionally, increased asymmetry levels in more degraded habitats, as recorded in this study, are believed to reflect stresses that may negatively affect the bird community and then fluctuating asymmetry estimation can be a sensitive indicator of environmental stress acting as an early warning system which allows remedial conservation action to be taken (Clarke 1995).

In the present study three traits were evaluated, which were different in sensibility. The highest levels of fluctuating asymmetry were found in hallux, while tarsus had intermediate values and wing-length had the lowest asymmetry. The above differences in fluctuating asymmetry may be explained in terms of their developmental origin, degree of integration and selective forces implies during their development (Aparicio & Bonal, 2002; Balmford et. al., 1993). It means that each trait can suffer different levels of canalization and genetic control occurs separately for different characters (Evans 1993). As a result each trait has different sensibility under stressful conditions. Besides, some authors have pointed out that the fluctuating asymmetry in an individual character should not be taken as a measure of phenotypic quality for a bird since a individual could have for instance symmetric wings but asymmetric tarsi (Evans 1993; Palmer 1994; Dufour & Weatherhead 1996). Nonetheless, it has been concluded that alteration in wing asymmetry might be more representative of disruption of developmental stability than asymmetry in another character, (Evans,Martins & Haley, 1995).

Changes in vegetation structure can affect insectivorous birds in their foraging behavior as they are usually extremely specialized in their prey search and attack tactics (Cody 1985). Our results in the foraging guild analysis support this hypothesis because only in insectivores forest quality indicators (leaf litter depth and basal area of trees) were negative correlated with fluctuating asymmetry values.

CONCLUSIONS AND RECOMMENDATIONS

The use of simple and accurate biomarkers, such as individual asymmetry, can allow us to measure the impact of habitat disturbance before species become irreversibly affected, and then taking appropriate conservation action (Clarke 1995). Application of such an individual-level approach suggests that conservation tactics are successful if its include action both within sites and across landscapes (Anciães & Marini, 2000). In the case of T nicefori, a new natural reserve has been established but now it is necessary to begin to work in across landscapes perspectives, looking for additional populations and seeking ways to maintain connectivity between fragments.

The greater part of field studies addressing the consequences of fragmentation on developmental stability have focused on particular species with conservation problems (Sarre, 1996; Wauters et al., 1996; Lens et al., 1999; Marchand et al., 2003). Nevertheless, this study shows that at communities and foraging guild level it is possible to find fluctuating asymmetries correlated with the habitat quality and therefore, have an approach about the most sensible guild or species. Additionally, it is possible to determine what the habitat characteristics that correlate better with fluctuating asymmetry are and then, including this information in restorations plans.

3.2.2. POPULATION MONITORING PROGRAM FOR THE THREATENED SPECIES ON THE PROTECTED AREA.

(By Sandra Valderrama)
The new natural reserve Cucarachero del Chicamocha, is unique because of their ecological characteristics, and because is the habitat of the Niceforo's Wren, a territorial and critically endangered songbird species (BirdLife Internacional 2000). In addition to its restricted range, these birds are threatened due to habitat destruction (Valderrama 2005, Parra et al. 2006).

Potential habitats were identified on maps, satellite images and directly in the field according to previous studies and records of the species (Valderrama 2005, Parra et al. 2006, Valderrama et al. 2007ab, Valderrama et al. 2008). Once these areas were identified census were taken along transects.

In total, within the Natural reserve, 11 individuals were found. This results show this region provides a suitable habitat for being used by Niceforo's Wrens and is one of the most important found in the Chicamocha to date (the other one is located in the Soata municipality (Cortes, pers Comm). In other areas in the Chicamocha, individuals face severe fragmentation due multiple antropogenic pressures (Valderrama 2005, Parra et al. 2006).

3.3 BIODIVERSITY SURVEYS:

INTRODUCTION

Animal and plants inventories are the base to amplify knowledge about Colombian biodiversity. It is crucial to know, assess, and rationalize uses of biodiversity and to establish actions to protect it. In Colombia, a megadiverse country there is still scarcity on knowledge about the existing number of plants and animals. There are many endangered species still unknown, or even worse there are some extinct species which never were known. The dry forest is not only one of the most threatened and fragmented ecosystems in the world, but also is one of the most unknown. In the Chicamocha canyon it have been carried out few inventories of plants (Albesiano 2003, 2006), and birds (Parra et al. 2006). Moreover, there are not records of other groups. The recent created Natural reserve Cucarachero de Chicamocha is an ideal area to start doing this kind of studies, because in future the ecosystem recovering could be assessed through the recuperation of its fauna and flora. Here, we carried out inventories of amphibians and reptiles, bats, birds, and phytophagous insects in the Natural Reserve Cucarachero de Chicamocha.

3.3.1. AMPHIBIAN AND REPTILES

(By Juan Salvador Mendoza)

BACKGROUND

The Colombian central Andean región, where is located the Chicamocha canyon, is one of the regions with the greatest diversity of reptiles (Sanchez 1995). Moreover, The Chicamocha canyon is the habitat of three known endemic species of reptiles and amphibians: a species of salamander, a snake coral and a lizard (Bolitoglossa nicefori Brame and Wake 1963, Micrurus sangilensis Niceforo-Maria, 1942 y Stenocercus santander Torres- Carvajal, 2007).
As objects of study, reptiles and amphibians have been ideal organisms for the quantification of general ecological processes. Moreover, they are considered important organisms in measuring the impact and recovery in natural areas because they respond to the alteration of habitats by fragmentation events, deforestation, pollution, climate change and invasive species (Pianka 1980). Especially, amphibians serve as biomarkers of high fidelity (Duellman 1999), becoming ideal focal organisms to quantify the state of conservation of an ecosystem.

The insufficient knowledge about natural populations of reptiles and amphibians, and especially about those living in dry forests, hindering the establishment of conservation criteria to many species. Hence, there is an urgent need to include their study in conservation plans.

OBJECTIVE

- 1.Complete an inventory of amphibians and reptiles in the Natural Reserve Cucarachero de Chicamocha

METHODS

Daily and nocturnal samplings were carried out during the rainy season (April) and dry season (June). Ten lineal transects of 400mx2m were distributed in five different habitats (Table 3.7). Transects were checked three times per day (morning, noon, and afternoon) through active searching removing logs, stones, and leaf litter. Amphibian and reptiles were recorded and observations and photographs were taken. Ten pitfall traps were located in four transects and individuals captured were sexed, measured, and identified to species using specialized keys (Peters & Orejas 1970, Campbell & Lamar 2004, Lynch 1999, Cuentas et al. 2002).

Table 3.7. Survey habitat types at Reserva Natural Cucarachero de Chicamocha

Survey site	GPS coordinates	Altitude
Andean dry forest	06°49’20.2’’ N 073°13’11.0’’ W	1031
Riparian forest	06°49’00.7’’ N 073°12’36.8’’ W	678
Mist Forest	06°49’19.0’’ N 073°13’53.1’’ W	1664
Agroforestry	06°49’02.3’’ N 073°12’46.3’’ W	746
Cuji Forest	06°51’07.9’’ N 073°13’21.5’’ W	800

A list of the species recorded was obtained; and richness and diversity analysis were calculated with the programme Biodiversity pro (Mac Aleece 1997). Beta diversity was evaluated by using Jaccard cluster analyses (Mac Aleece 1997). Daily activity patterns were analyzed graphically for some species during dry and rainy seasons.

RESULTS

In April, 31 species of reptiles and six species of amphibians were recorded. In June, the number of reptiles increased to 35, and the number of amphibians to eight. In regard to reptiles, there were 23 species of snakes represented in five families, and 19 genera with Colubridae and Elapidae as the most diverse families. There were 11 species of saurian represented in five families, and 11 genera with Gymnophthalmidae and Geckonidae as the most diverse families. Only one species of tortoise was found. In regard to amphibians, there were eight species of two orders Anura and Gymnophiona, four families and six genera with Hylidae and Brachycephalidae as the most diverse families (Table 3.8).

Table 3.8. List of species found in ADF: Andean dry forest, RF: riparian Forest, CF: cuji forest, AGR: agroforestry, MF: mist Forest, REP: species reported in interviews, OBS: species observed in the field. Also, species found in rainy and dry seasons.

Families	Species	ADF	RF	CF	AGR	MF	OBS	REP	Rainy season	Dry season
	OPHIDIA									
	Erytrholamprus bizona			X				X		X
	Lampropeltis triangulum	X				X	X	X	X	X
	Drymarchon corais	X				X		X		
	Masticophis mentovarius	X					X	X		X
	Imantodes cenchoa	X						X		X
	Helicops aff. Angulata		X					X		X
	Sibon nebulata	X						X		X
COLUBRIDAE	*Oxybelis aneus*	X	X				X	X	X	X
	Mastigodryas pleei	X	X	X		X	X		X	
	Mastigodryas boddaerti		X			X	X	X	X	X
	Clelia clelia	X						X		
	Spilotes pullatus	X	X				X	X	X	X
	Leptophis ahetulla		X					X	X	X
	Liophis sp1.				X			X		X
	Liophis sp 2.	X			X		X			X
	Oxyrhopus petola	X		X				X		X
VIPERIDAE	*Bothrops asper*				X			X		
	Crotalus durissus		X	X				X		X
	Micrurus mipartitus				X			X		X
ELAPIDAE	*Micrurus sanjilensis*	X		X				X		X
	Micrurus aff. Dumerilli	X						X		
LEPTOTYPHLOPIDAE	*Leptotyphlops aff. macrolepis*	X				X	X	X	X	X
BOIDAE	*Boa constrictor constrictor*	X	X	X			X	X	X	X
	SAURIA									
IGUANIDAE	*Iguana iguana*		X	X	X	X	X	X	X	X
POLYCRHOTIDAE	*Polychrus gutturosus*	X	X					X		X
TROPIDIURIDAE	*Stenocercus Santander*	X	X			X	X		X	X
	Thecadactylus rapicauda		X		X		X	X	X	X
GECKONIDAE	*Hemidactylus brooki*			X	X		X	X	X	X
	Gonatodes albogularis	X	X	X	X	X	X	X	X	X
	Lepidoblepharis sp.		X			X	X		X	
TEIIDAE	*Ameiva ameiva*	X		X	X		X		X	X
	Cnemidophorus lemniscatus	X	X	X	X		X		X	X
	Bachia sp.		X		X		X		X	X
GYMNOPHTHALMIDAE	*Gymnophthalmus speciosus*	X					X		X	
	Tretioscincus biffaciatus		X		X		X	X	X	X
	TESTUDINES									
TESTUDINIDAE	*Chelonoidis carbonaria*			X				X		X
	AMPHIBIA									
ANURA										
LEPTODACTYLIDAE	*Engystomops pustulosus*		X	X	X	X	X		X	X
BRACHYCEPHALIDAE	*Pristimantis sp 1*					X	X		X	X
	Pristimantis sp 2.					X	X		X	
HYLIDAE	*Hypsiboans sp 1.*		X		X		X		X	X
	Hypsiboans sp 2.	X			X		X		X	X
BUFONIDAE	*Bufo sp.*	X						X	X	
	Rhinella marinus				X		X		X	X
GYMNOPHIONA										
CAECILIDAE	*Caecilia aff. Degenerata*					X	X			X

Results showed that the Andean dry forest has the highest richness and diversity followed by the riparian forest, agroforestry, cuji forest, and mist forest respectively (Table 3.9, Fig.3.15). Hill's numbers indicate that the habitats with greater number of rare species are the Andean dry forest and riparian forests (Fig.3.16).

Table 3.9. Species Richness in ADF: Andean dry forest, RF: Riparian Forest, CF: Cuji forest, AGR: Agro ecosystems, and MF: Mist Forest

Habitat Type	Amphibian species	Exclusive species of amphibians	Reptile species	Exclusive species of Reptiles	Total Richness
ADF	2	2	21	6	23
RF	2	0	17	2	19
CF	1	0	12	2	13
AGRO	4	1	12	3	16
MF	4	3	9	0	13

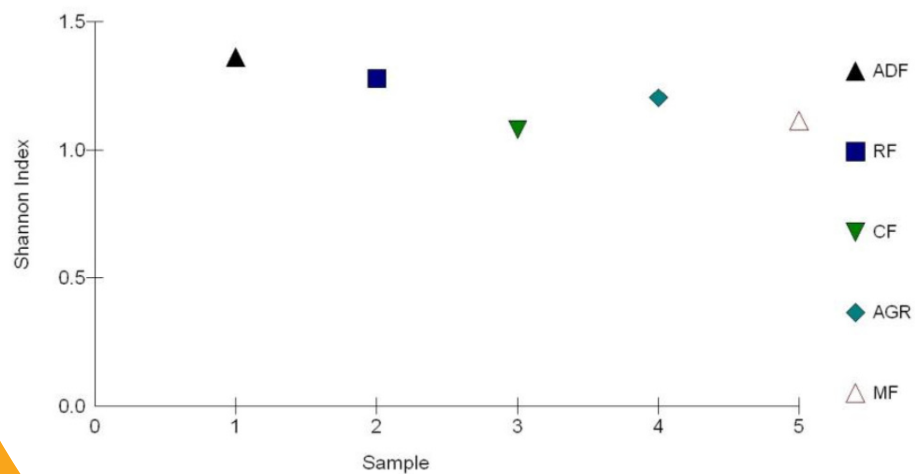


Figure 3.15. Shannon diversity index for ADF: Andean dry forest, RF: Riparian Forest, CF: Cuji forest, AGR: Agro ecosystems, and MF: Mist Forest

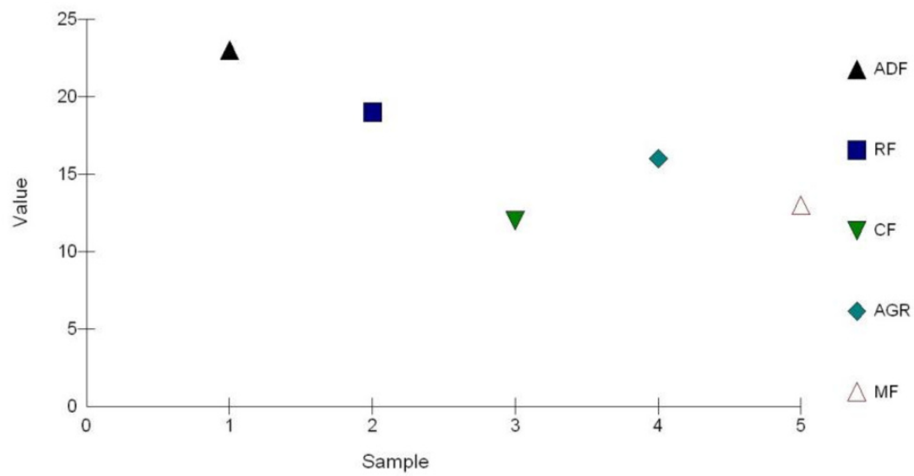


Figure 3.16.Hills number for ADF: Andean dry forest, RF: Riparian Forest, CF: Cuji forest, AGR: Agro ecosystems, and MF: Mist Forest

The Jaccard cluster analysis showed that the habitats which share more species are cuji forest and agroforestry. On the other hand, Andean dry forest shares only 16% of species with the other forest types (Fig.3.17).

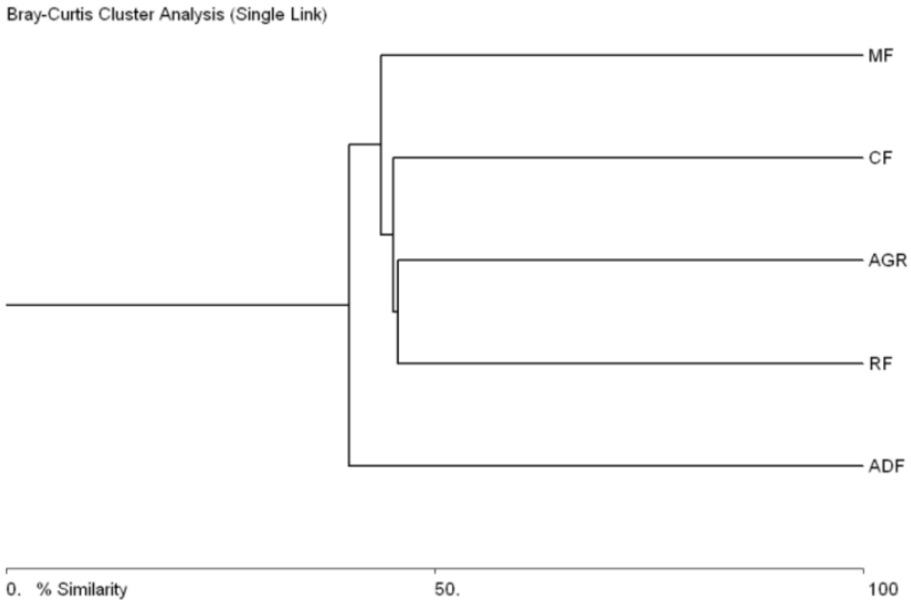


Figure 3.17. Jaccard similarity dendrogram between ADF: Andean dry forest, RF: Riparian Forest, CF: Cuji forest, AGR: Agro ecosystems, and MF: Mist Forest

Figure 3.18. A. Gonatodes albogularis, B. Mastigodryas pleei depredating Cnemidophorus lemniscatus, C. Cnemidophorus lemniscatus (female), and D. Cnemidophorus lemniscatus (male).

Activity patterns

Activity patters were recorded for some species found in two transects. In the Andean dry forest in April, the lizard Gonatodes albogularis (Fig. 3.18 A) and the snake Mastigodryas pleii (Fig. 3.18 B) showed bimodal peaks of activity during morning hours and late afternoon. The lizard Cnemidophorus lemniscatus (Fig.3.18 C) showed a late afternoon peak of activity, and Ameiva ameiva and Stenocercus santander (Fig. 3.18 D) showed early morning activity (Fig. 3.19).

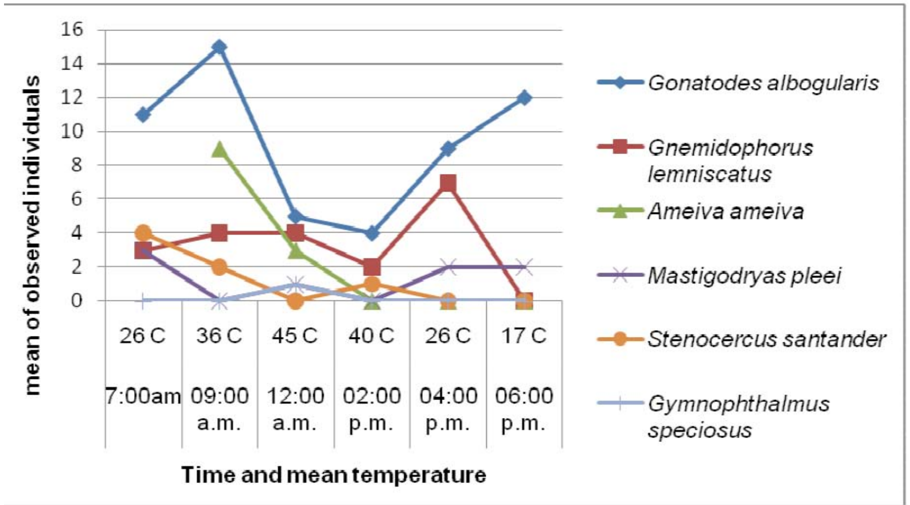


Figure 3.19. Activity patterns at Andean dry forest in April

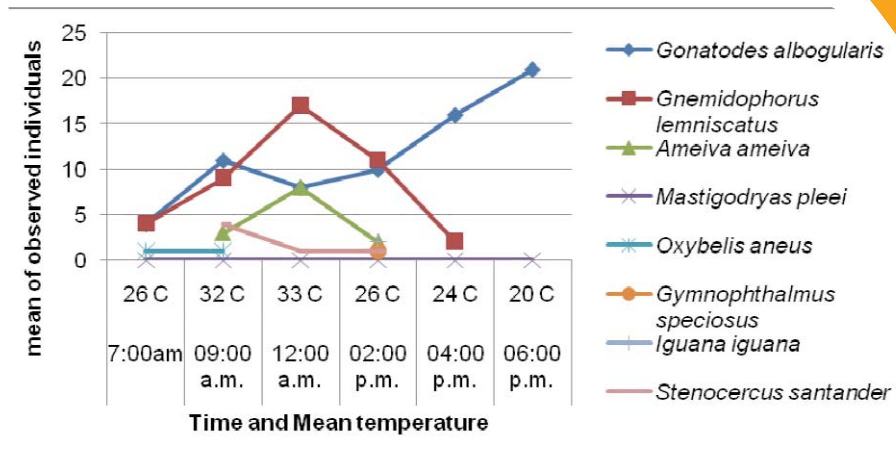


Figure 3.21. Activity patterns at Andean dry forest in June

In the Andean dry forest in June activity patterns showed significant variation. Most species have temporal shifts in their diurnal activities. For example Gonatodes albogularis was more active late in afternoon; Cnemidophorus lemniscatus and Ameiva ameiva in hot mid day hours; Stenocercus santander (Fig. 3.20 A) has low variation in their daily activity, Mastigodryas pleii was completely absent during the this period and Oxybelis aneus (Fig. 3.20B) was found for first time (Fig. 3.21).

Figure 3.20. A. Stenocercus Santander (male), B. Oxybelis aneus

For riparian forest in April, results showed a bimodal activity for C. lemniscatus, and G. albogularis with peaks at morning and afternoon. Tretioscincus biffaciatus (Fig. 3.22 A) has a peak of at morning (Fig. 3.23).

Figure 3.22. A. Tretioscincus biffaciatus, B. Mastigodryas boddaerti

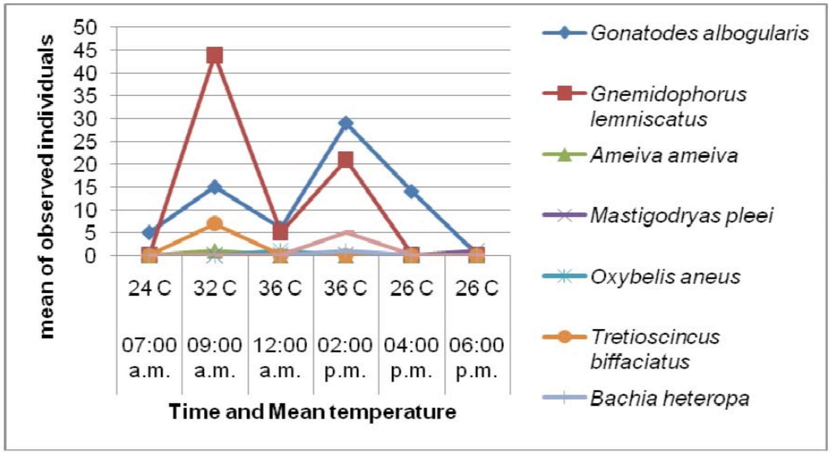


Figure 3.23. Activity patterns at riparian forest in April

During June at the riparian forest species such as G. albogularis and G. lemniscatus were extremely actives at noon(Fig. 3.22). Species such as Bachia sp. and Oxybelis aneus were not record in this month, while Thecadactylus rapicauda, Stenocercus Santander, and Mastigodryas boddaerti (Fig. 3.23) were recorded for first time (Fig. 3.24).

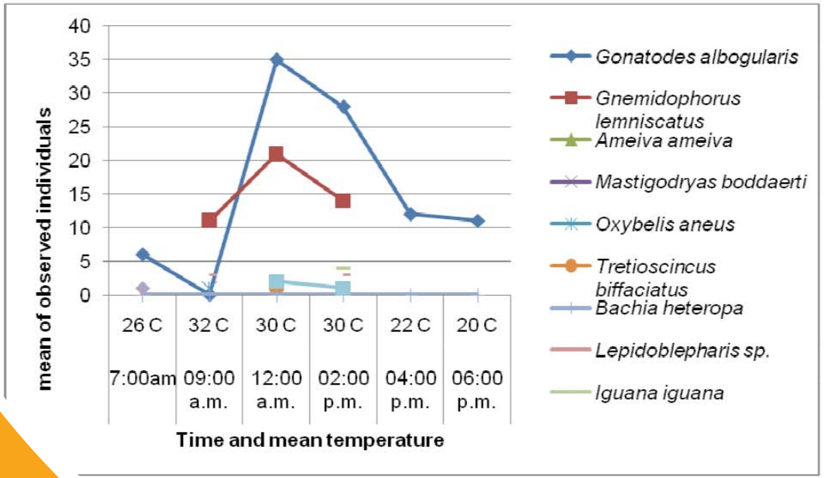


Fig. 3.24. Activity patterns at riparian forest in June

DISCUSSION

Reptile and amphibian species are different between sites and seasons. Ecological requirements, predation, and competition explain variation in composition of herpetological assemblages, and daily activity (Daza et al. 2006, Amat 2002, Mendoza unpublished data).

Landscapes are difficult to treat as independent units because species such as snakes can move through a wider range of habitats. Riparian forest serves as connectors between habitats which extending from the Chicamocha River to the mist forest from 300m to 2100m of altitude. This habitat serves as a biological corridor allowing gradual movements of species such as arboreal snakes and mountain lizards. Moreover, riparian forests serves as shelter of species sensitive to temperature and humidity such as amphibians and leaf litter reptiles. This habitat posses unique microhabitats; positive hygrometric gradients, high leaf litter accumulation, rich epiphytic vegetation, and an extensive canopy cover which contribute with higher diversity levels.

Cuji forest holds low species richness. This habitat is characterized by having poor structured vegetation with uncovered patches which allow sun rays to heat the ground. In a similar way, agroforestry areas posses clear patches with reduced vegetation These common characteristics between the two habitats explain the high percentage of similarity between them (31,57%) and the lower species diversity. However, agroforestry sites show a rich arthropod fauna which attract some reptiles. Moreover, artificial water reservoirs attract amphibian species.

In the study area, there are two endemic species: the coral snake Micrurus sanjilensis and the saurian Stenocercus Santander. We also confirm a first record for the rattle snake (Crotalus durissus cumanensis) at the reserve. Interviews with locals point out to the presence of Amphisbaena fulginos, but this result needs to be confirmed. Also, snakes of genera Enuliophis, Atractus and Leptodeira; and saurian of genera Basiliscus and Ptychoglossus were reported by locals.

3.3.2 BATS

(By Manuel Rodriguez & Elizabeth Bahamon)

BACKGROUND

Bats are characterized for being a group of animals which offer varied and complete information about ecosystems health (Rodríguez-Mahecha et al. 2006). Their close relation with the environment, make them an indicator group of ecosystem changes. Bats have crucial ecological functions in the ecosystems because they participate in different trophic roles as: frugivores, nectarivores, polinivores, insectivores, piscivorous, carnivores, and hemotophages. They deserve as major insect-controllers and pollinators in ecosystems worldwide. Also, they pollinate more than 130 genera of plants, and disperse abundant number of seeds for forest recovering. Therefore, any change that occurs in the ecosystem affects bats directly (Fleming 1998; Bawa 1990; Brooke 1994, Fleming & Sosa 1994). Here, we pretend to shed light on the bat composition in the Reserva Natural Cucarachero de Chicamocha, to begin conservation practices for this group of animals and its habitat.

OBJECTIVES

- 1. Evaluate the structure and composition of bats assemblage in the Reserva Natural Cucarachero de Chicamocha
- 2. Identify the main problems between bat communities and locals

METHODS

- Study Area

The study was developed in three habitats which differ in composition and vegetation structure: Cuji forest characterized by abundance of Prosopis sp and cactus; riparian forest composed by plants such as Ceiba sp, Ficus sp, Cecropia sp and Clusia sp between others; and goat's area which is similar in plants composition to the Cuji forets but with higher abundance of goats. In these areas, there is an elevated incidence of bats' attacks to the local population (Rodriguez pers. com)

- Bats sampling

Mist nets of 50/2 denier, 38 mm (Avinet) were located in the understory during new moon from 15 to 30 of August 2009. Between four and eight nets were used each night from 17:50 to 01:00, and were checked each 20minutes. Each net measures 6mx3m. Bats captured were measured, weighed, and sexed followed the methodology of Kunz et al. (2002). Age of individuals was determined. In total 181.75 hours/net were accumulated, and data were corrected by the effort to make the results comparable (Table 3.10).

Habitat Type	Hours * Net
Cuji Forest	47,5
Riparian Forest	83,25
Goats area	51
TOTAL	181,75

*Table 3.10. Hour*Net for habitat type*

Individuals were identified to species using the following taxonomic keys: Muñoz (2001), Tirira (2000), Emmons et al. (1997) and Sanchez et al. (2004). The principal characteristics to identify species were pelage density, dental formulas, and morphological measures. Bat distribution was corroborated with the guide Matilla-Meluk et al. (2009). Cumulative samples curves were done to determine the sampling effort, and Shannon diversity and Jaccard similarity indexes were estimated in Biodiversity Pro (Mac Aleece 1997).

RESULTS AND DISCUSSION

In total 129 individuals belonging to 14 species and five trophic groups were captured. At Cuji forest the insectivore species Glossophaga longirostris was the most abundant (Table 3.11). Though this species is insectivore, it also takes nectar from flowers. Its abundance can be explained for the abundance of cactus in the reserve, this species has been reported feeding on pollen and nectar of Agave (Lemke 1984; Willig 1983). G. longirostris is a data deficient species (IUCN 2010), and its abundance in the reserve should be exploited through starting studies aimed to amplify its knowledge.

The vulnerable species Rhogeessa minutilla (IUCN 2010) was found at cuji and riparian forests. This insectivorous species lives in holes in columnar cactus arms (Soriano pers com), reason why it is found in the Chicamocha. On the other hand, there was a higher abundance of A. jamaicensis, a nomadic frugivore species at the riparian forest (Table 2). The abundance of this species is important in vegetation recovering processes in the reserve; because nomadic frugivores feed on trees with massive, short-duration fruits, and move away to different regions of the forest dispersing seeds and helping the plants regeneration (Soriano 2000).

Finally at the goat's area, there were elevated quantities of hematophages species as Desmodus rotundus (Table 3.11). Hematophages species are a problem for local people because they are considerate a big threat for goat practices, one of the main economical activities in the region.

Table 3.11. Percentage of relative species abundance. Trophic levels: N = Nectarivores, NF = Nomadic Frugivores, SF = Sedentary Frugivores, H = Hematophages, I = Insectivores. IUCN Categories: DD = Data deficient, LC = Least concern, and E = Endemic.

Table 3.11. Percentage of relative species abundance. Trophic levels: N = Nectarivores, NF = Nomadic Frugivores, SF = Sedentary Frugivores, H = Hematophages, I = Insectivores. IUCN Categories: DD = Data deficient, LC = Least concern, and E = Endemic.

				Percentage of abundance			
N	***Spp***	**Trophic levels**	**UICN**	**Cuji Forest**	**Riparian Forest**	**Goats Area**	**TOTAL**
1	*G.longirostris*	N	DD	66	14	53	44
3	*A.jamaicensis*	NF	LC	7	36	5	16
6	*D. rotundus*	H	LC	5	0	26	10
4	*D.glaucus*	NF	LC	11	14	5	10
7	*S. tildae*	FS	LC	5	14	0	6
2	*A.lituraturs*	NF	LC	5	5	0	3
13	*C.perspicillata*	FS	LC	0	3	5	3
14	*P.discolor*	NF	LC	0	0	5	2
5	*D.phaeotis*	NF	LC	0	5	0	2
12	*P.helleri*	NF	LC	0	5	0	2
9	*R. minutilla*	I	VU	2	2	0	1
8	*S. lilium*	FS	LC	0	2	0	1
10	*P.brachycephalus*	NF	LC	0	2	0	1
11	*M. nigricans*	I	LC	0	2	0	1

Results indicate that sampling effort was satisfactory, 88% of expected species were collected (Fig.3.25). In studies carried out in dry forests, similar a superior diversity indexes have been found (Cadena et al, 1998; Sánchez et al. 2007).

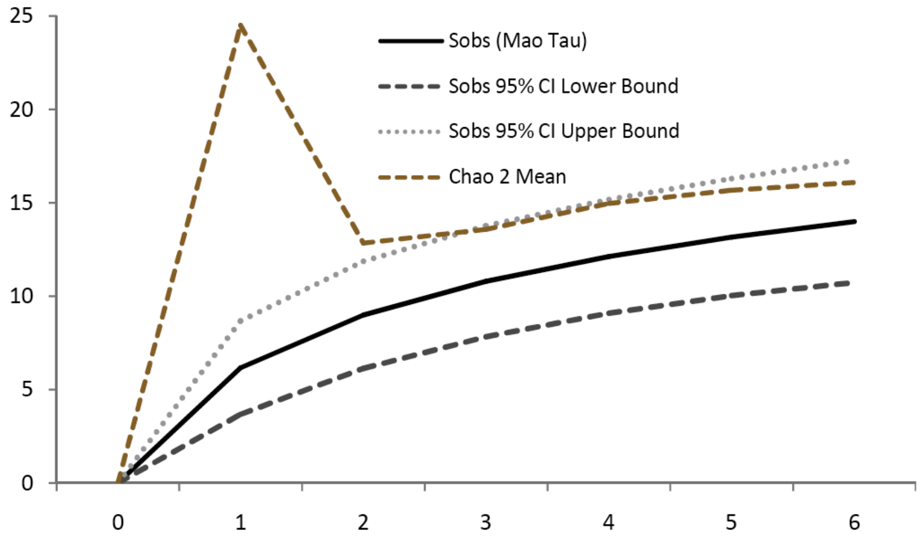


Figure 3.25. Cumulative number of bat species. Sobs: Number of species collected. Chao 2: estimators of expected number of species.

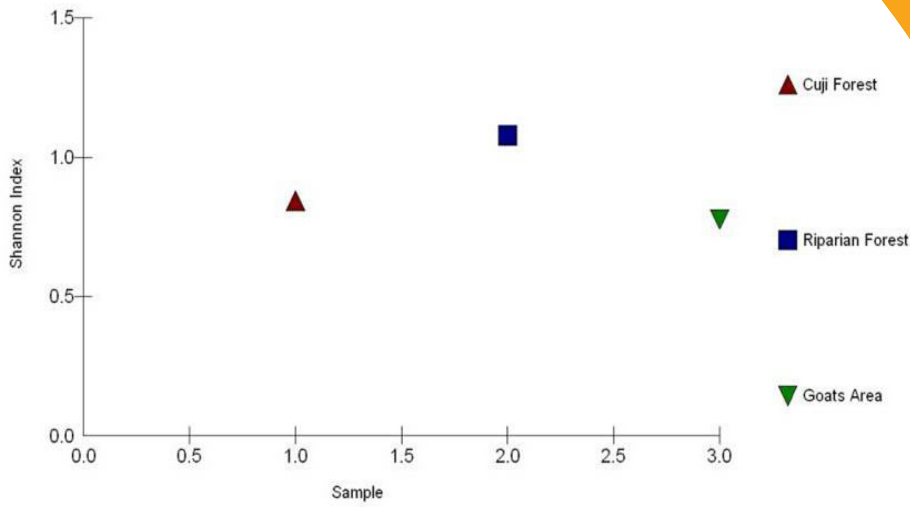


Figure 3.26. Shannon diversity index in Cuji forest, riparian forest and goats' area.

Diversity indexes show the highest diversity of bats in riparian forest (Fig.3.26). This result could be related with the higher diversity of plants in this habitat, caused by the abundance of soil nutriments (Albesiano 2006). Riparian forest offers a high variety of fruits contributing to the higher diversity of frugivore bats in this habitat (Table 3.11.) Similarity indexes showed that Cuji forest and riparian forest, and Cuji forest and goats area share more the species than riparian forest and goats areas (Table 3.12).

Table 3.12. Jaccard similarity index between habitats

	Cuji Forest	Riparian Forest	Goats Area
Cuji Forest	*	63.16	61.54
Riparian Forest	*	*	44.45
Goats Area	*	*	*

Goat's livestock are one of the main economical activities of inhabitants in the Chicamocha, and they blame bats as the main transmitter of rabia and anemia to the goats. Therefore, they try to eradicate hematophagous bats using wrong procedures and affecting negatively all bat communities. On the other hand, indiscriminate use of resources and ecotourism are having negative effects in bat's communities. It is evident that important shelters for bats such as caves are being used in some cases to do concerts which affect dramatically populations of bats in the area.

CONCLUSIONS

The Chicamocha canyon not only is habitat of endangered species of birds, but also is home of the unknown Glossophaga longirostris and the vulnerable Rhogeessa minutilla. In order to increase knowledge about these species and start working in their conservation, it is necessary to start doing studies in the region about their life history, ecological requirements, and main threats.

It is urgent to do an environmental education work with locals about the ecological importance of bats, and make them aware about the ecological impact which can be caused by eradication of not hematophagous species. Moreover, it is important to give them knowledge about the benefits that bats offer to humans as: pollinators, seed dispersers, and insect regulators.

Finally, it is necessary and urgent to develop studies to determine the conservation status of caves in the region, aimed to create management plans for its conservation.

3.3.3. AVES

(By Jorge Parra, Marcela Beltrán, Alejandro Lozano, Antonio Quiñones & Valentina Gómez)

OBJECTIVE

- 1. Carry out an inventory of birds in The Natural reserve Cucarachero de Chicamocha and its surroundings

METHODS

A total of three mist nets were located during four days in the surroundings of the natural Reserve from 6:30 to 10:30. The sampling effort was 48 hours-net. Moreover transects were located in the Natural reserve during five days, to record the bird species from 6:00 to 10:30. Data were divided in 13 sample units following Villareal et al. (2006). The graphic of cumulative samples was done in Estimates 7.5 (Colwell 2009), and diversity index was obtained using Biodiverity Pro (Mac Aleece 1997).

BACKGROUND

Birds along the Chicamocha canyon were inventoried in the first part of the Project Chicamocha. New records of species were revealed, and the Chicamocha canyon was established as an important bird area (Parra et al. 2006). However, studies were not focused on a particular area, but also on many points through Santander and Boyacá departments. After the establishment of the Natural Reserve Cucarachero de Chicamocha, we decided to carry out a study of birds composition in the new reserve aimed to complement the later study.

RESULTS

In total 64 species were recorded, and the Shannon diversity index was 0.95. This number of species represents 72% of the expected, which indicates that the study needs more sampling effort (Fig 3.27). However in the first part of the project Chicamocha, when the reserve had not been established yet, a rapid characterization was carried out in the area and other species of birds were recorded. Here we show the total list of birds of the new natural reserve Cucarachero de Chicamocha (Table 3.33). There is about 104 species in the reserve, it is possible that including the species of the first part of the project in the analysis, the value of the expected species achieves the estimator Chao 2.

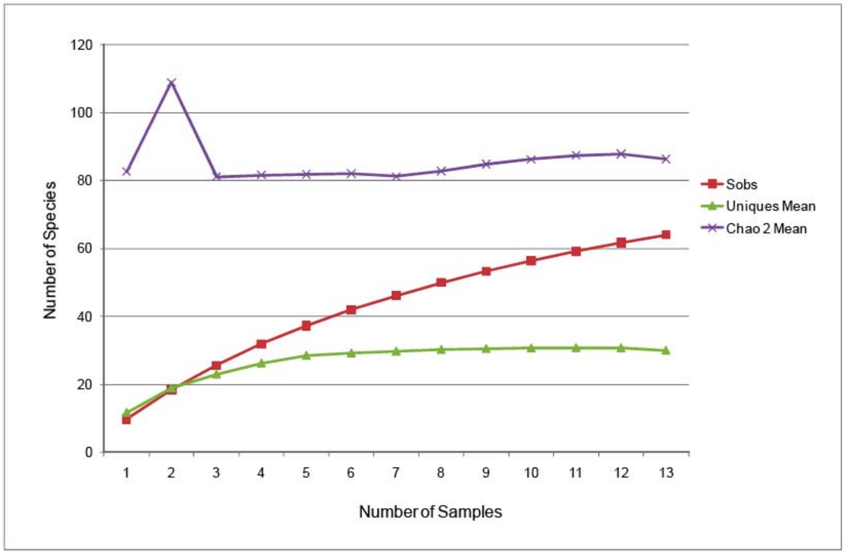


Figure 3.27. Cumulative species of birds in the Natural reserve Cucarachero de Chicamocha. Sobs Mean: Number of species collected; singletons Mean: Number of species found in one sample: ACE and Chao 2: Estimator of expected number of species

Table 3.13. Total list of bird species.

N	Family	Species	English name	Status
1	ACCIPITRIDAE	*Buteo albicaudatus*	White-tailed Hawk	LC
2		*Buteo magnirostris*	Roadside Hawk	LC
3		*Chondrohierax uncinatus*	Hook-billed Kite	LC
4		*Geranoaetus melanoleucus*	Black-chested Buzzard-eagle	LC
5	CAPRIMULGIDAE	*Caprimulgus cayennensis*	White-tailed Nightjar	LC
6		*Herpsilochmus rufimarginatus*	Rufous-winged Antwren	LC
7		*Nyctidromus albicollis*	Common Pauraque	LC
8	APODIDAE	*Streptoprocne rutila*	Chestnut-collared Swift	LC
9		*Streptoprocne zonaris*	White-collared Swift	LC
10		*Aeronautes montivagus*	White-tipped Swift	LC
11	CARDINALINAE	*Saltator albicollis*	Lesser Antillean Saltator	LC
12	CATHARTIDAE	*Cathartes aura*	Turkey Vulture	LC
13		*Coragyps atratus*	Black Vulture	LC
14	COLUMBIDAE	*Columba fasciata*	Band-tailed Pigeon	LC
15		*Columbina minuta*	Plain-breasted Ground-dove	LC
16		*Columbina passerina*	Common Ground-dove	LC
17		*Columbina talpacoti*	Ruddy Ground-dove	LC
18		*Leptotila rufaxilla*	Grey-fronted Dove	LC
19		*Leptotila verreauxi*	White-tipped Dove	LC
20		*Zenaida auriculata*	Eared Dove	LC
21	CRACIDAE	*Ortalis colombiana*	Colombian Chachalaca	LC
22	CUCULIDAE	*Crotophaga ani*	Smooth-billed Ani	LC
23		*Crotophaga sulcirostris*	Groove-billed Ani	LC
24		*Piaya cayana*	Squirrel Cuckoo	LC
25		*Tapera naevia*	Striped Cuckoo	LC
26		*Coccyzus americanus*	Yellow-billed Cuckoo	LC
27		*Piaya minuta*	Little Cuckoo	LC
28	DENDROCOLAPTIDAE	*Campylorhamphus trochilirostris*	Red-billed Scythebill	LC
29		*Xiphorhynchus picus*	Straight-billed Woodcreeper	LC
30	EMBERIZINAE	*Arremon schlegeli*	Golden-winged Sparrow	LC
31		*Sicalis flaveola*	Saffron Finch	LC
32		*Tiaris bicolor*	Black-faced Grassquit	LC
33	FALCONIDAE	*Falco femoralis*	Aplomado Falcon	LC
34		*Falco rufigularis*	Bat Falcon	LC
35		*Falco sparverius*	(American Kestrel	LC
36		*Milvago chimachima*	Yellow-headed Caracara	LC
37	FORMICARIIDAE	*Formicivora grisea*	White-fringed Antwren	LC
38		*Thamnophilus multistriatus*	Bar-crested Antshrike	LC
39	FURNARIIDAE	*Synallaxis albescens*	Pale-breasted Spinetail	LC
40	HIRUNDINIDAE	*Notiochelidon cyanoleuca*	Blue-and-white Swallow	LC
41		*Stelgidopteryx ruficollis*	Southern Rough-winged Swallow	LC
42	ICTERIDAE	*Icterus chrysater*	Yellow-backed Oriole	LC
43		*Icterus icterus*	Venezuelan Troupial	LC
44		*Icterus nigrogularis*	Yellow Oriole	LC
45	MIMIDAE	*Mimus gilvus*	Tropical Mockingbird	LC
46	MOMOTIDAE	*Momotus momota*	Blue-crowned Motmot	LC
47	PARULINAE	*Basileuterus culicivorus*	Golden-crowned Warbler	LC
48		*Basileuterus rufifrons*	Rufous-capped Warbler	LC
49		*Coereba flaveola*	Bananaquit	LC
50		*Dendroica fusca*	Blackburnian Warbler	LC
51		*Dendroica striata*	Blackpoll Warbler	LC
52		*Parula pitiayumi*	Tropical Parula	LC
53		*Seiurus noveboracensis*	Northern Waterthrush	LC
54		*Vermivora chrysoptera*	Golden-winged Warbler	LC
55		*Vermivora peregrina*	Tennessee Warbler	LC

56	PHASIANIDAE	*Colinus cristatus*	Crested Bobwhite	LC
57	PICIDAE	*Colaptes punctigula*	Spot-breasted Woodpecker	LC
58		*Melanerpes rubricapillus*	Red-crowned Woodpecker	LC
59		*Picumnus squamulatus*	Scaled Piculet	LC
60		*Picumnus olivaceus*	Olivaceous Piculet	LC
61		*Veniliornis kirkii*	Red-rumped Woodpecker	LC
62		*Veniliornis passerinus*	Little Woodpecker	LC
63		*Dryocopus lineatus*	Lineated Woodpecker	LC
64		*Picumnus granadensis*	Greyish Piculet	LC
65	PSITTACIDAE	*Amazona ochrocephala*	Yellow-crowned Amazon	LC
66		*Forpus conspicillatus*	Spectacled Parrotlet	LC
67	THRAUPINAE	*Euphonia laniirostris*	Thick-billed Euphonia	LC
68		*Tangara vitriolina*	Scrub Tanager	LC
69		*Thraupis episcopus*	Blue-grey Tanager	LC
70		*Thraupis palmarum*	Palm Tanager	LC
71		*Habia rubica*	Red-crowned Ant-tanager	LC
72		*Piranga flava*	Hepatic Tanager	LC
73	TROCHILIDAE	***Amazilia castaneiventris***	**Chestnut-bellied Hummingbird**	**EN**
74		*Chlorostilbon gibsoni*	Red-billed Emerald	LC
75		*Chlorostilbon mellisugus*	Blue-tailed Emerald	LC
76		*Doryfera ludoviciae*	Green-fronted Lancebill	LC
77		*Anthracothorax nigricollis*	Black-throated Mango	LC
78	TROGLODYTIDAE	*Campylorhynchus griseus*	Bicoloured Wren	LC
79		***Thryothorus nicefori***	**Niceforo's Wren**	**CR**
80		*Troglodytes aedon*	House Wren	LC
81	TURDINAE	*Catharus ustulatus*	Swainson's Thrush	LC
82		*Turdus ignobilis*	Black-billed Thrush	LC
83		*Turdus leucomelas*	Pale-breasted Thrush	LC
84	TYRANNIDAE	*Camptostoma obsoletum*	Southern Beardless-tyrannulet	LC
85		*Elaenia flavogaster*	Yellow-bellied Elaenia	LC
86		*Elaenia frantzii*	Mountain Elaenia	LC
87		*Euscarthmus meloryphus*	Tawny-crowned Pygmy-tyrant	LC
88		*Hemitriccus margaritaceiventer*	Pearly-vented Tody-tyrant	LC
89		*Leptopogon superciliaris*	Slaty-capped Flycatcher	LC
90		*Machetornis rixosus*	Cattle Tyrant	LC
91		*Myiarchus apicalis*	Apical Flycatcher	LC
92		*Myiarchus tyrannulus*	Brown-crested Flycatcher	LC
93		*Myiodynastes maculatus*	Streaked Flycatcher	LC
94		*Myiozetetes cayanensis*	Rusty-margined Flycatcher	LC

95		*Pitangus sulphuratus*	Great Kiskadee	LC
96		*Pyrocephalus rubinus*	Vermilion Flycatcher	LC
97		*Sayornis nigricans*	Black Phoebe	LC
98		*Todirostrum cinereum*	Common Tody-flycatcher	LC
99		*Tolmomyias sulphurescens*	Yellow-olive Flycatcher	LC
100		*Tyrannus melancholicus*	Tropical Kingbird	LC
101	VIREONIDAE	*Cyclarhis gujanensis*	Rufous-browed Peppershrike	LC
102		*Hylophilus flavipes*	Scrub Greenlet	LC
103		*Vireo leucophrys*	Brown-capped Vireo	LC
104		*Vireo olivaceus*	Red-eyed Vireo	LC

DISCUSSION

The species of birds reported here are important contributions to the knowledge of the birds of the Chicamocha canyon. Since the first surveys of birds, the region has been considered a centre of speciation by its endemism such as the Niceforo's wren and the Chestnut billed hummingbird. The diversity of birds in the region is consequence of the different habitats created in the East-Andes of Colombia. The Chicamocha canyon has a huge gradient of elevation between 300 and 2500 metres with different weather conditions. One unique habitat is the dry forest which is relatively isolated by valleys from other similar habitats. Therefore, it has been suggested that this isolation has produce a unique flora and fauna. However, the dry forest of Chicamocha valleys is suffering an intense deforestation and desertification. In 2005, Project Chicamocha proposed the Chicamocha canyon as important bird area by its unique avifauna and take conservation actions in the region. The importance of the region is not only because of its endemic birds but also for the conservation of resident and migratory species found in different habitats.

This project encourages a continuum monitoring programme of bird populations through the Chicamocha canyon to know how different habitats behave due to global warming. This is a simple and practicable way for assessing habitat quality. In addition, results of a monitoring programme will increase knowledge of the ecosystem services and will provide recommendations for decision-makers in the region.

3.3.4 PHYTOPHAGOUS INSECTS

(By Marcela Beltrán)

Sponsored by: British ecological society

BACKGROUND

Although strong seasonal trends of insects abundance, diversity and lifeway are found in temperate ecosystems, temporal variation in assemblages of field and crown layer arthropods can be just as pronounced, in supposedly aseasonal tropical climates. Many abiotic or biotic factors, with direct or indirect effects, affect variation in community structure of tropical insect herbivores and one of the most significant is the availability of and feeding specificity on host and/ or food plants. Studies on their seasonality in the Neotropical region have concentrated on tropical rain forest. Little is known about the tropical dry forests being these ecosystems some of the most threat in the world. Studies of diversity of flora and fauna in the dry forest are scarce. The idea of this work is to know the phytophagous population patterns, before the goats' removal, and in future continue monitoring phytophagous insects periodically to determine how the ecosystem is recovered.

OBJECTIVES

- 1. Determine the seasonality of phytophagous insects associated with three habitat types in a low crown dry forest system in the Chicamocha canyon of Colombia, prior to removal of domesticated grazing goats in the recent created Reserva Natural Cucarachero de Chicamocha.

METHODS

- Study Area

The study was carried out in the Natural Reserve Cucarachero de Chicamocha during two periods in the rainy season: October 2008 and April 2009, and two periods in the dry season February and July 2009.

- Phytophagous sampling

Four Malaise traps (Fig. 1) were located in three different habitat types: dry forest per se, gallery forest, and crop system; for 8 days during each period. Target groups were: Cicadellidae or leaf hoppers (Hemiptera), Orthoptera s.l, Chrysomelidae or leaf beetles (Coleoptera), and sawflies and bees (Hymenoptera). Each group was identified to the minimum possible taxonomic level using taxonomic keys (Daly 1998, Borror et al 1992). Insects were preserved in 80% ethanol and located in the entomological collection at the natural history museum of Universidad Nacional de Colombia and Universidad de Los Andes in Colombia. Cumulative number graphs were done using the estimative Chao1 in Estimates 8.2 (Colwell 2009). A graphic analysis was done to explain similarities or contrasts of the number of morphotypes among seasons for each habitat type. Shannon diversity indexes were obtained with the programme Biodiverity Pro (Mac Aleece 1997).

Figure 3.28. Malaise trap in the crop habitat

RESULTS AND DISCUSSION

During all the study 43 morphotypes belonging to 7 subfamilies of leaf-hoppers were found, the cumulative plot of the number of morphotypes showed that we collected 95% of the expected species (Fig 3.29, Table 3.34). Figure 3.30 shows a sample of 2 subfamilies of leaf-hoppers.

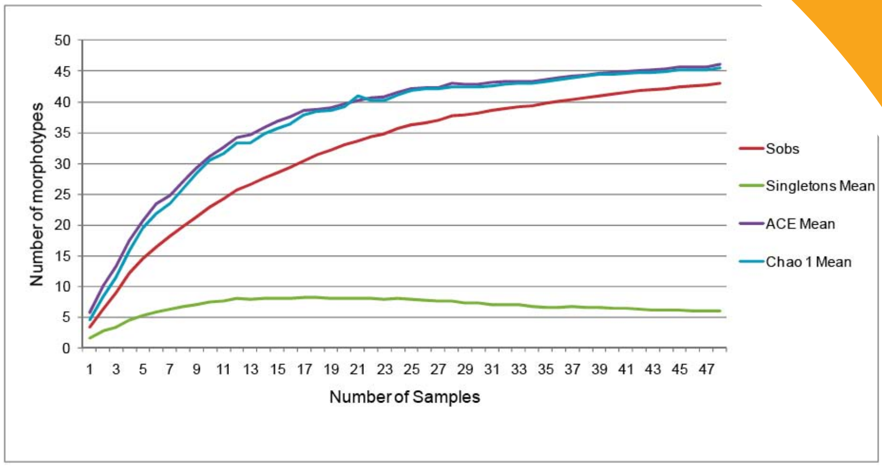


Figure 3.29. Cumulative number of Cicadellidae morphotypes. Sobs Mean: Number of species collected; singletons Mean: Number of species found in one sample: ACE and Chao 1:Estimators of expected number of species

Table 3.14. Total abundance of Cicadellide morphotypes

Subfamilia	Total abundance
Coelidiinae morphotype 1	4
Typhlocybinae morphotype 1	18
Typhlocybinae morphotype 2	57
Deltocephalinae morphotype 1	28
Deltocephalinae morphotype 2	7
Typhlocybinae morphotype 3	8
Typhlocybinae morphotype 4	51
Deltocephalinae morphotype 3	23
Typhlocybinae morphotype 5	4
Deltocephalinae morphotype 4	5
Aphrodinae morphotype 1	7
Iassinae morphotype 1	2
Deltocephalinae morphotype 5	5
Iassinae morphotype 2	3

Deltocephalinae morphotype 6	10
Deltocephalinae morphotype 7	3
Typhlocybinae morphotype 6	1
Typhlocybinae morphotype 8	86
Cicadellinae morphotype 1	13
Aphrodinae morphotype 2	2
Neopsinae morphotype 1	12
Typhlocybinae morphotype 9	2
Typhlocybinae morphotype 10	1
Typhlocybinae morphotype 11	61
Deltocephalinae morphotype 8	4
Deltocephalinae morphotype 9	17
Typhlocybinae morphotype 12	31
Deltocephalinae morphotype 9	4
Iassinae morphotype 4	1
Deltocephalinae morphotype 10	13
Deltocephalinae morphotype 11	36
Typhlocybinae morphotype 13	5
Iassinae morphotype 3	8
Typhlocybinae morphotype 14	12
Deltocephalinae morphotype 12	6
Coelidiinae morphotype 2	1
Aphrodinae morphotype 2	1
Coelidiinae morphotype 3	12
Typhlocybinae morphotype 15	2
Deltocephalinae morphotype 13	1
Typhlocybinae morphotype 16	5
Neopsinae morphotype 2	2
Deltocephalinae morphotype 14	4

Figure 3.30. Pictures of two subfamilies of leaf-hoppers. Left: Deltocephalinae, and right: Coeliidinae.

Five morphotypes belonging to 3 families of Orthoptera were collected; the cumulative plot of the number of morphotypes showed a collection of 99% of the estimated species (Fig 3.31, table 3.15).

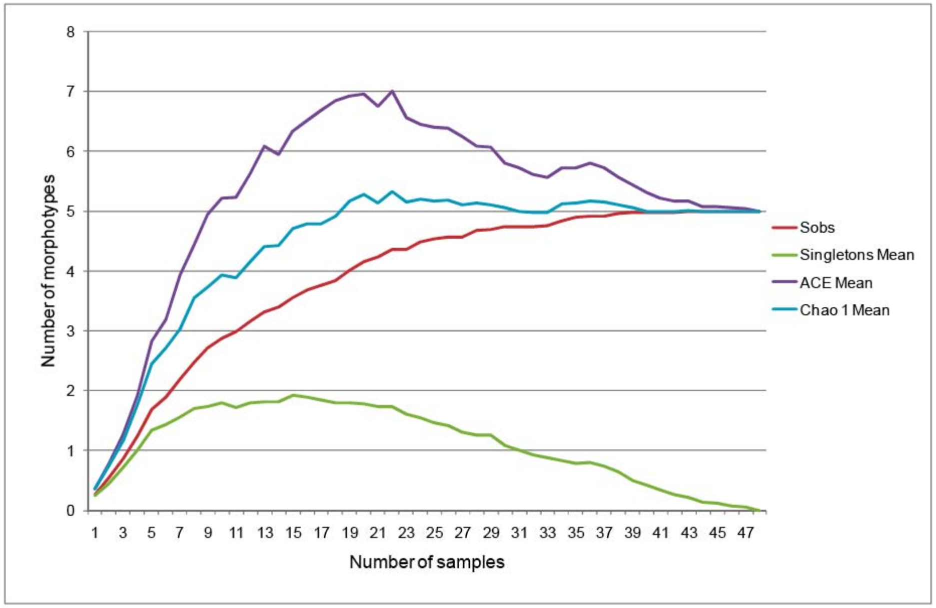


Figure 3.31. Cumulative number of Orthoptera morphotypes. Sobs Mean: Number of species collected; singletons Mean: Number of species found in one sample: ACE and Chao 1:Estimators of expected number of species

Morphotype	Total Abundance
Acrididae morphotype 1	2
Tettigoniidae morphotype 1	9
Acrididae morphotype 2	3
Acrididae morphotype 3	3
Gryllidae morphotype 1	4

Table 3.15. Total abundance of Orthoptera morphotypes

In addition, 50 morphotypes belonging to Family Chrysomelidae were found, it was 80% of the expected species (Fig 3.32, Table 3.16).

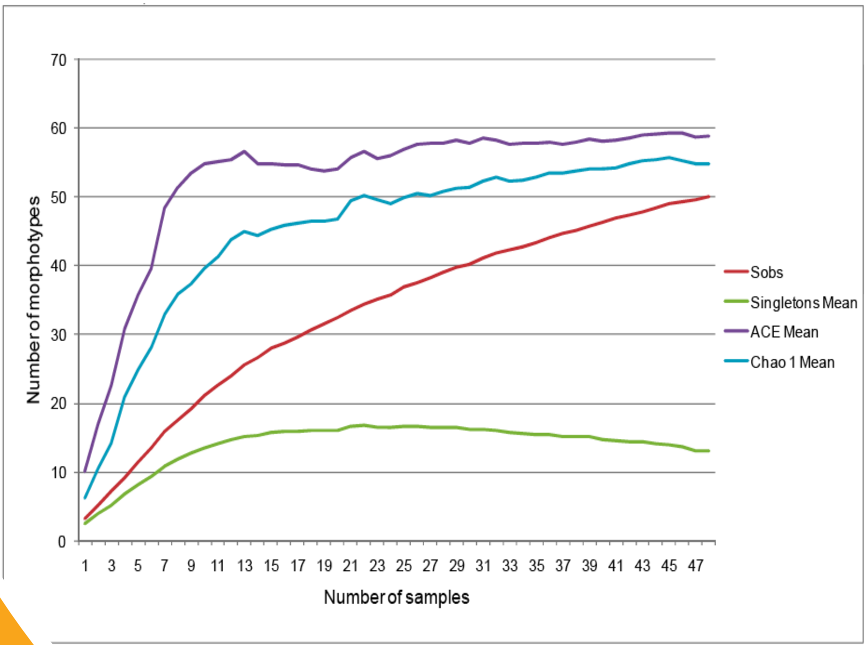


Figure 3.32. Cumulative number of Chrysomelidae morphotypes. Sobs Mean: Number of species collected; singletons Mean: Number of species found in one sample: ACE and Chao 1: Estimators of expected number of species

Table 3.16. Total abundance of Chrysomelidae morphotypes

Morphotype	Total Abundane
Chrysomelodae morphotype 1	14
Chrysomelodae morphotype 2	6
Chrysomelodae morphotype 3	4
Chrysomelodae morphotype 4	1
Chrysomelodae morphotype 5	2
Chrysomelodae morphotype 6	4
Chrysomelodae morphotype 7	3
Chrysomelodae morphotype 8	4
Chrysomelodae morphotype 9	5
Chrysomelodae morphotype 10	2
Chrysomelodae morphotype 11	2
Chrysomelodae morphotype 12	4
Chrysomelodae morphotype 13	2
Chrysomelodae morphotype 14	3
Chrysomelodae morphotype 15	3
Chrysomelodae morphotype 16	13
Chrysomelodae morphotype 17	4
Chrysomelodae morphotype 18	6
Chrysomelodae morphotype 19	4
Chrysomelodae morphotype 20	1
Chrysomelodae morphotype 21	2
Chrysomelodae morphotype 22	8
Chrysomelodae morphotype 23	2
Chrysomelodae morphotype 24	2

Chrysomelodae morphotype 25	2
Chrysomelodae morphotype 26	1
Chrysomelodae morphotype 27	3
Chrysomelodae morphotype 28	5
Chrysomelodae morphotype 29	1
Chrysomelodae morphotype 30	21
Chrysomelodae morphotype 31	2
Chrysomelodae morphotype 32	1
Chrysomelodae morphotype 33	2
Chrysomelodae morphotype 34	2
Chrysomelodae morphotype 35	2
Chrysomelodae morphotype 36	2
Chrysomelodae morphotype 37	1
Chrysomelodae morphotype 38	8
Chrysomelodae morphotype 39	2
Chrysomelodae morphotype 40	1
Chrysomelodae morphotype 41	1
Chrysomelodae morphotype 42	1
Chrysomelodae morphotype 43	1
Chrysomelodae morphotype 44	1
Chrysomelodae morphotype 45	1
Chrysomelodae morphotype 46	3
Chrysomelodae morphotype 47	1
Chrysomelodae morphotype 48	3
Chrysomelodae morphotype 49	4
Chrysomelodae morphotype 50	2

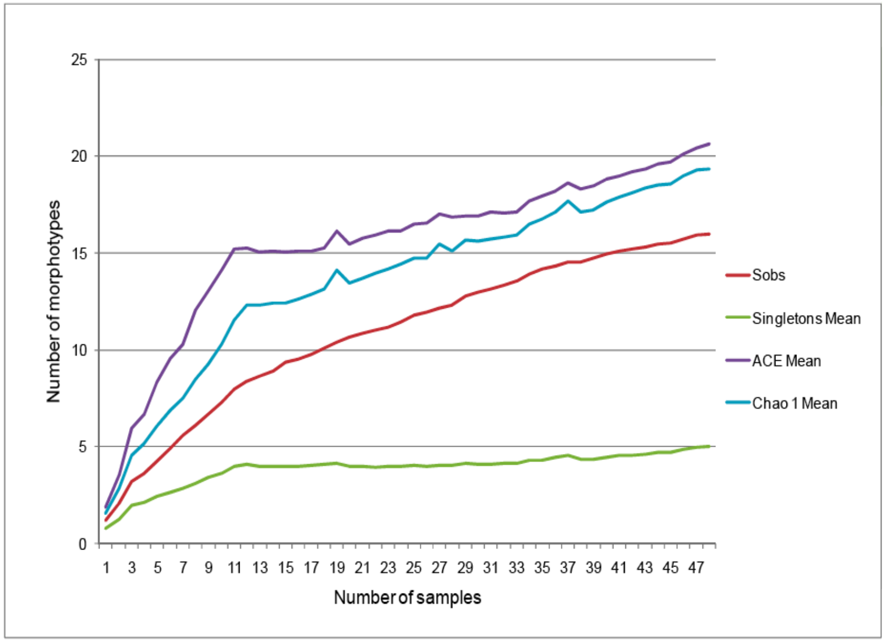


Figure 3.33. Cumulative number of bees morphotypes. Sobs Mean: Number of species collected; singletons Mean: Number of species found in one sample: ACE and Chao 1: Estimators of expected number of species

Finally, 16 morphotypes belonging to two families of bees were collected; it corresponded to 80% of the projected species (Fig 3.33, Table 3.17). No sawflies were found.

Table 3.17. Total abundance of bees morphotypes

Morfo	Total Abundance
Apidae morphotype 1	11
Halictidae morphotype 1	7
Halictidae morphotype 2	18
Apidae morphotype 2	0
Apidae morphotype 3	2
Apidae morphotype 4	4
Halictidae morphotype 3	6
Halictidae morphotype 4	0
Apidae morphotype 5	1
Apidae morphotype 6	3
Apidae morphotype 7	1
Apidae morphotype 8	2
Apidae morphotype 9	15
Halictidae morphotype 5	1
Apidae morphotype 10	2
Apidae morphotype 11	1

The results indicate that sampling effort was successful because we found more than 80% of the expected species for each taxa. Results in general showed a high species richness variability during the seasons and inconsistent trends. These results can be explained because of the impact of grazing activity caused by goats to vegetation. Goats can kill woody plants through the destruction of phloem and vascular cambium (Hendrix 1988). Also, they produce alterations in vegetation growing patterns, affecting phytophagous insects which depend on plants availability. For example, it has been reported that food for most of leaf-hoppers is specific, reason why leaf-hoppers richness may be related with some plant species and their phenology (Borror et al 1992, Chaves & Avalos 2006, Wolda 1978). However, there were not marked richness trends for leaf-hoppers (Fig 3.34). This result can be explained due to the variation in plants phenology at the Chicamocha. For example, during dry seasons some trees and shrubs lose their foliage, some drop their leaves in both seasons, other only in the driest season, and the remaining such as Stenocereus griseus, Opuntia dillenii, Mammillaria columbiana, Melocactus pescaderensis and Furcraea sp., continue with their physiological activity even the driest conditions, because of their capacity of store water (Albesiano et al. 2003). Shannon diversity index showed no difference between the three habitats types diversity for Cicadellidae (Fig 3.35).

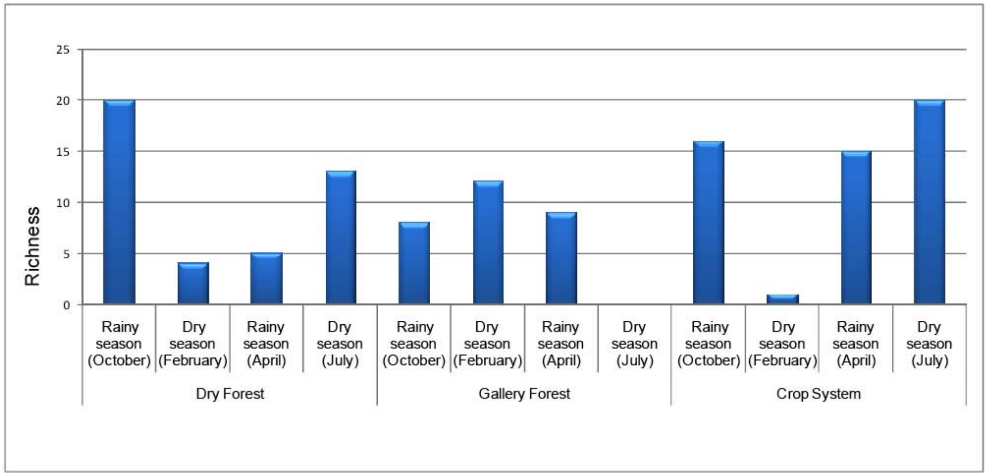


Figure 3.34. Cicadellidae richness in each period for each habitat type

There were scarcity of Orthopterans, and species richness was low in the dry forest and the gallery forest. The Chicamocha canyon is characterized for having highly eroded and rocky soils, which allow few quantities of grass to growth, affecting grasshopper's abundance. Moreover, presence of goats produces a reduction in grass abundance. Regard to the crop system; it had a higher richness of Orthopterans in comparison with the other habitat types, because its frequent irrigation makes grasses abundant all the year (Fig 3.36). Dry forest and Crop system had the highest level of diversity, followed for the gallery forest (Fig 3.37).

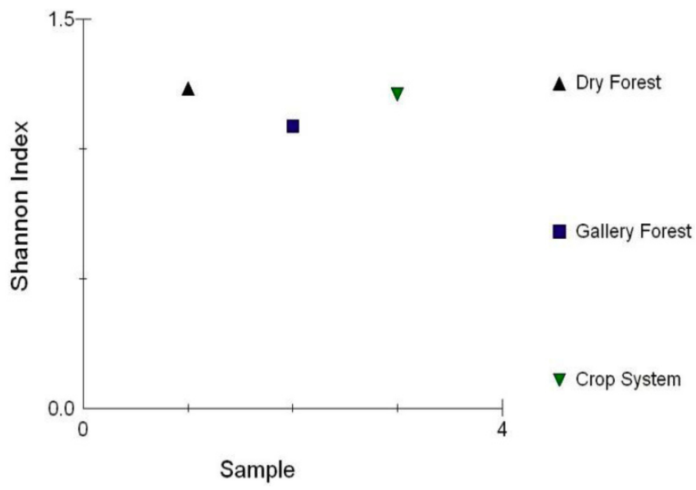


Figure 3.35. Cicadellidae Shannon Diversity Index for each habitat type.

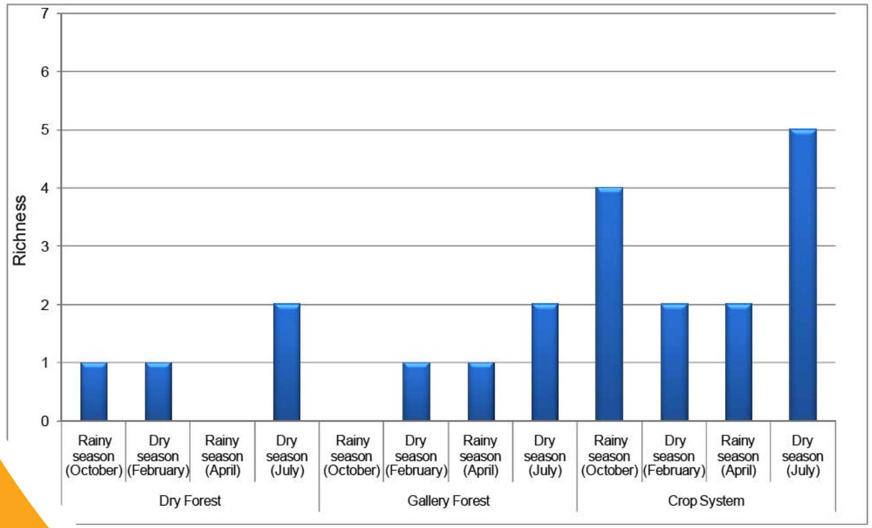


Figure 3.36. Orthoptera richness in each period for each habitat type.

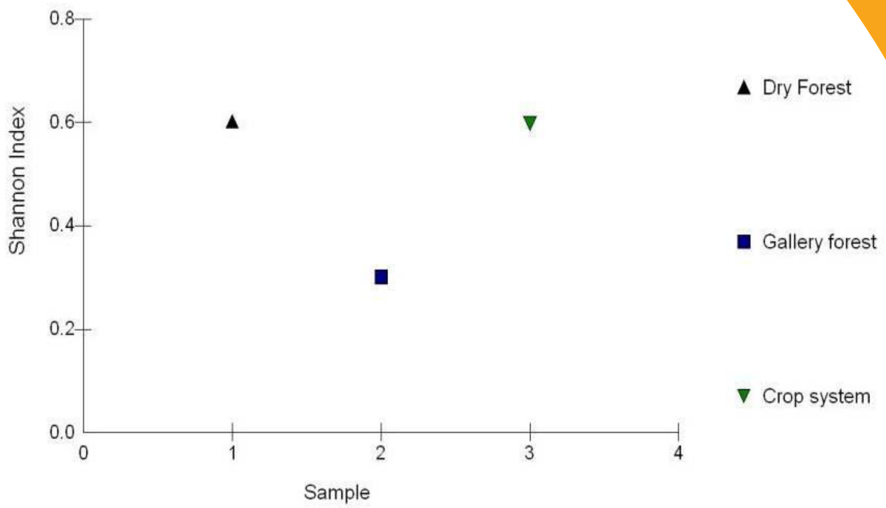


Figure 3.37. Orthoptera Shannon Diversity Index for each habitat type.

For Chrysomelidae, richness in three habitat types had a peak in October, which is the month with the maximun level of precipitation (Albesiano et al. 2003). Many species of leaf beetles remain inactive until rainy season activate them (Wolda & Denlinger 1984, Young 1979, Bethke & Redak 1996). However, rains in April do not produce increases in Chrysomelidae abundance (Fig. 3.38).
Crop system had the highest diversity of Chrysomelidae followed by the dry forest and Gallery forest (Fig 3.39).

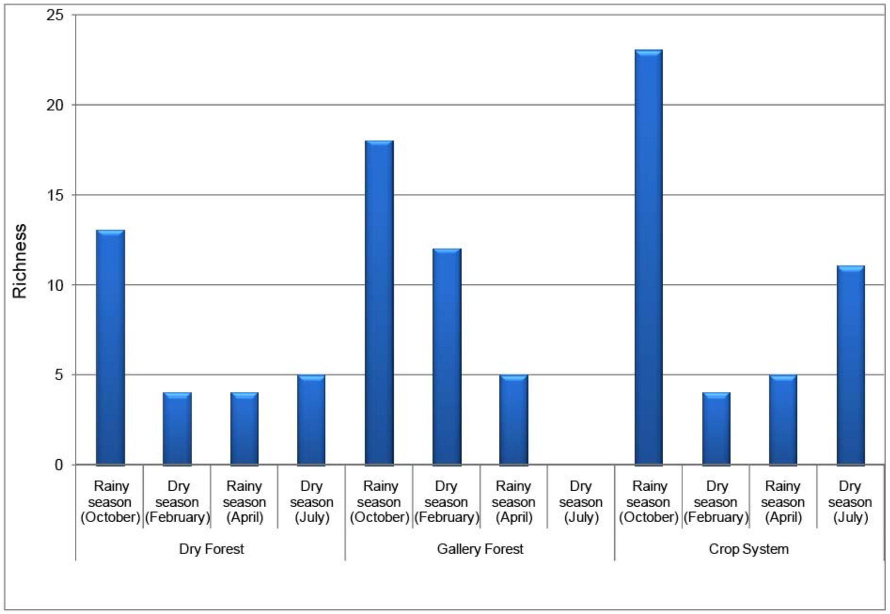


Figure 3.38. Chrysomelidae richness in each period for each habitat type.

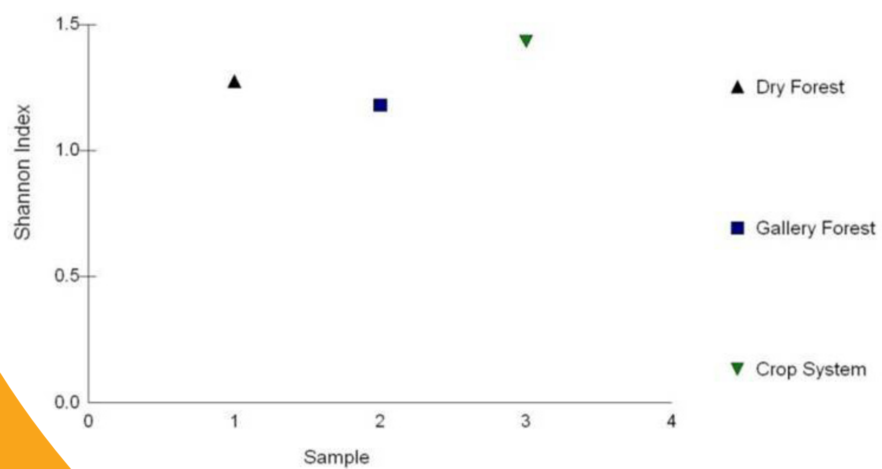


Figure 3.39. Chrysomelidae Shannon Diversity Index for each habitat type.

The crop system had the highest richness and diversity of bees. It is probably explained by the presence of crops such as zapote (Matisia cordata), papaya (Carica papaya), avocado (Persea americana), guava (Psidium guajava) mandarin (Citrus reticulata), lemon (Citrus limonum), tamarindo (Tamarindus indica), coconuts (Cocos nucifera), which are likely pollinated by this group of insects (Fig 3.40, Fig 3.41) (Blanche et al 2006, Ricketts 2004, Heard 1999). Crop pollination by wild bees is an enormous valuable ecosystem service, but it is under increasing threat from goat cattle intensification. Goats not only exploit bees' food resources, but also destroy bees' perennial nests.

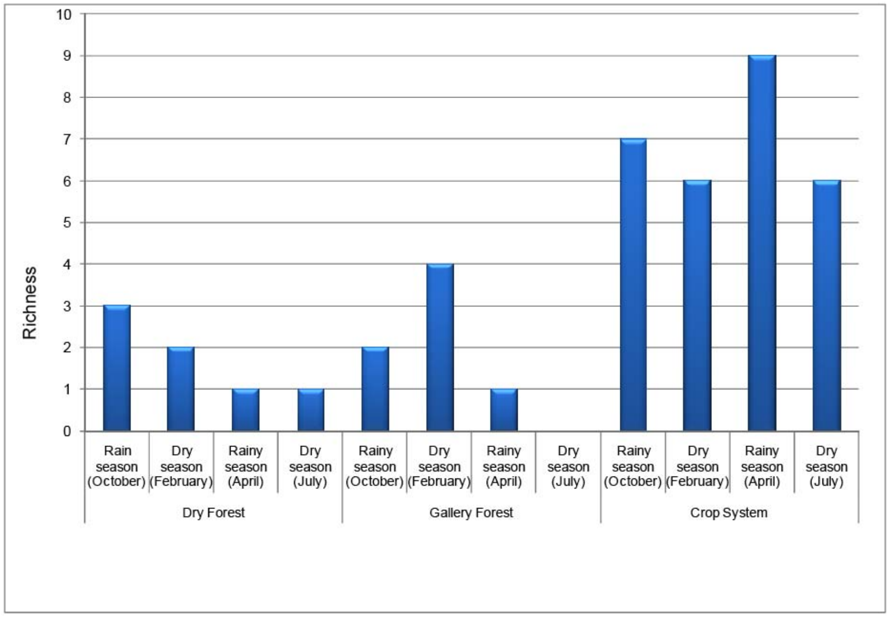


Figure 3.40. Bees richness in each period for each habitat type

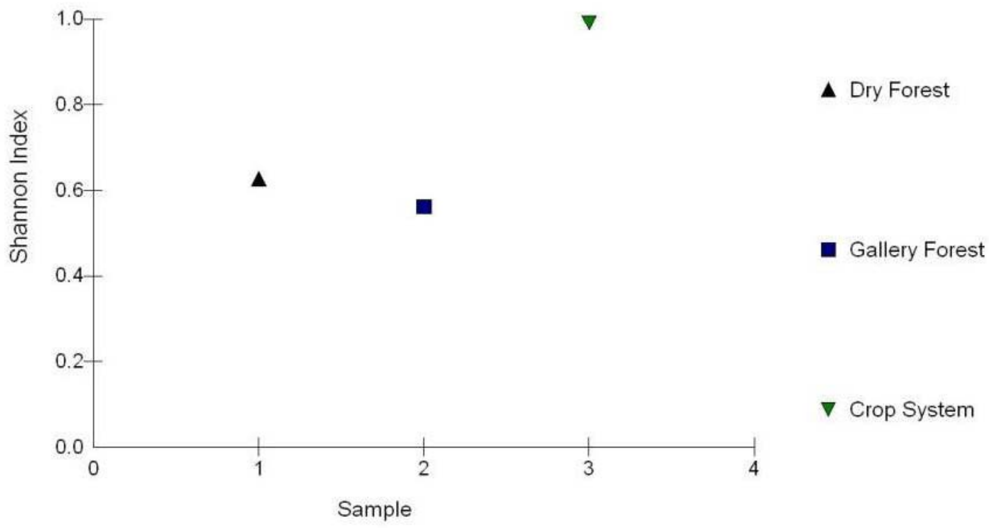


Figure 3.41. Bees Shannon Diversity Index for each habitat type.

CONCLUSIONS

Unmarked trends through the seasons in some phytophagous insects could be explained since goat grazing effect. Leaf-hoppers could be affected by lack of leaves, Orthopterans by grass insufficiency, and bees due to their habitat destruction and scarcity of food produced by goats' pressure. It is crucial to continue monitoring populations of these groups of insects in the future, to determine how the ecosystem is being recovered after the goats elimination. Moreover, It is important to determine how the new natural reserve, which is one of the best fragments of tropical dry forest in the Chicamocha region, is a potential reservoir of insects that could enhance crop pollination throughout the region.

CONCLUSIONS AND GENERAL RECOMMENDATIONS

By
Jorge Parra

The Chicamocha Project has been an invaluable challenge for the team members, allowing us to develop as professionals and to work for reaching our goals. Besides, the Chicamocha region gave us the opportunity to share with brave people, who living in one of the most isolated regions, were always willing to help and to give us a friendly hand.

In order to encourage people to protect endangered species and their habitat, it is important to provide feasible, environmentally-friendly alternatives. In the same way, proposals for solutions to environmental problems have greater acceptance and impact when they are developed by members of the local community. This perspective should be taken in to account in the next phases of this project.

For obtaining long lasting results, the work in the dry forest and especially in the habitat of T nicefori and A cataneiventris must continue. Due to this, it is necessary that next phases of the Chicamocha Project focus on working with the community generating proposals to allow the people of this region strengthen their environmental capacities and gradually move towards sustainable development in the region.

Knowing the species behavior and taxonomic status is essential to protect them. In the case of A. castaneiventris, results showed that protection strategies need to be focused not only on the Chicamocha canyon but also on the places where individuals are migrating. In the case of T. nicefori, this study showed that at communities and foraging guild level, fluctuating asymmetries correlated with the habitat quality and therefore, it gave us an approach about what are the most sensible guild and species. Additionally, it was possible to determine what the habitat characteristics that correlate better with fluctuating asymmetry are, and then, this information can be included in future restoration plans.

Due to the high levels of endemism in the Chicamocha region, this project encourages a continuum monitoring programme of bird populations through the Chicamocha canyon to know how different habitats behave due to 1) global warming, 2) changes in land use and 3) habitat perturbation. This is a simple and practicable way for assessing habitat quality. In addition, results of a monitoring programme will increase knowledge of the ecosystem services and will provide recommendations for decision-makers in the region.

The Chicamocha canyon not only is habitat of endangered species of birds, but also is home among others, of several species of bats such as the unknown Glossophaga longirostris and the vulnerable Rhogeessa minutilla. In order to start working in their conservation, it is necessary to increase knowledge about their life history, ecological requirements, and main threats. Additionally, environmental education work with locals is urgent. Besides, it is necessary and urgent to develop studies to determine the conservation status of caves in the region, aimed to create management plans for its conservation.

In the case of amphibian and reptiles as well as for other species, riparian forest serves as connectors between habitats which extending from the Chicamocha River to the mist forest from 300m to 2100m of altitude. This habitat serves as a biological corridor allowing gradual movements of species such as arboreal snakes and mountain lizards. Moreover, riparian forests serves as shelter of species sensitive to temperature and humidity such as amphibians and leaf litter reptiles. Owing to this, conservation strategies in the Chicamocha canyon should include riparian forest.

Even though the creation of the first dry forest reserve in the Chicamocha Canyon has been a significant achievement reached with the invaluable help of the Foundation ProAves, much remains to be done yet, and future work in the region should involve working with owners of forest fragments to create connectivity, the development of sustainable economic alternatives to communities, the implementation of bird population monitoring programs to assess the advances of the strategies, and the work with takers of decisions.

Finally, as a result of our experience throughout the Chicamocha Project, we decided to create a new NGO, Fundacion Conserva, an organization that ratify the commitment of project members with conservation and whose main objective is to work in the conservation of tropical species and ecosystems, providing scientific research, environmental education tools and sustainable development projects to local communities in Colombia.

ACKNOWLEDGEMENTS

The execution of this project depended on many people and we want to thank all of them and say that without their help this dream couldn't become in a reality.

We want to thank specially to CLP programme (BP, Conservation International, BirdLife International, Fauna & Flora International and Wildlife Conservation Society). You gave us not only the opportunity to share with other alumni but also the support, advice and friendship that enhance our capacities and allowed us to achieve our most important aims.

We are very grateful to the Fundacion ProAves, who through their donors, were managed to buy one of the most conserved dry forest fragments and thus established the first dry forest reserve in the Chicamocha canyon.

To Gerson, Ludy and Jessica, students that despite of the difficult terrain and the distance, accepted the challenge to working with us and shared their enthusiasm for nature. For their patience, for being a key part in the understanding of biodiversity and ecology of the dry forest inhabitants and for their commitment to doing things in the best way.

To our friends of the Foundation Chimbilakos, especially to Antonio and Valentina for their support in the field phase, for your confidence in us, fluctuating asymmetry and their love for the wren. To Manuel and Elizabeth, who carried out the characterization of bats in the reserve and also joined us in the environmental education work. Thanks to all of you, who joined and supported this project generously contributing their expertise and experience.

To Alejandro Lozano, who besides being an excellent partner in field, support the field work with the Niceforo's wren and carried out the vegetation characterization in T nicefori territories.

To Juan Salvador, for his passion for amphibians and reptiles and his perseverance during the field phases, which allow the realization of an excellent work on herps in the area.

To members of the Foundation Conserva, Oscar and Diana, who with their calm, companionship and experience contributed to this work and enabled us to perform our biggest dream: to form a new NGO to continue working for the conservation of biodiversity in Colombia.

To Zapatoca residents who heard us and were willing to learn about conservation and the dry forest and share with us their knowledge on the subject.

To Roque Acevedo and his family, who during the two phases of the project provided us their support, guided us and opened their hearts and minds to learn about conservation.

To teachers and children from the villages of Zapatoca, who gave us wonderful moments and encourage us to continue working on environmental education and conservation.

Finally, we thank T nicefori and A castaneiventris for allowing us to work with them, know them, understand them and admire them for their ability to survive despite the ecological and environmental challenges they are facing.

We want to thank to the British ecological society for their financial support during the phytophagous insects research.





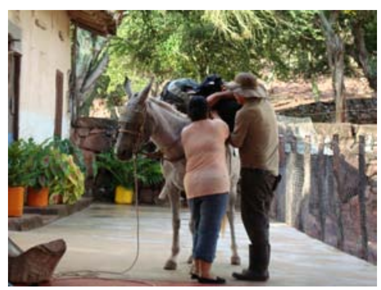
CARACOL
RADIO

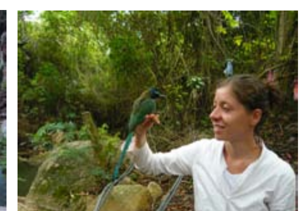












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