



Earthwatch 2014 Annual Field Report
TRACKING COSTA RICA'S MAMMALS

Margot Wood

PERIOD COVERED BY THIS REPORT: May 2014 - August 2014

Dear Volunteers,

What an amazing summer. It was a privilege working with you in the jungles of Costa Rica! We should be very proud of our research accomplishments. Everyone provided great motivation, and we very much appreciated your enthusiasm and drive for the research. From the muddy, moist vegetation plots, to the anticipation of peeking into small mammal traps, to the adventurous hikes checking camera traps, we are thankful for each and every minute of your time. Volunteers completed over 9,000 hours of citizen science data collection for this expedition! We had volunteers from all over the world and across all age groups, from 15 to 82!

Below is a summary of our achievements:

Camera and hair traps: We completed a total of 2,179 camera trapping nights and obtained pictures from 61 individual mammals (not including all of our *Homo sapiens* pictures), for a total of 25 different mammal species. Of the 25 species, 7 are considered nationally endangered in Costa Rica! Examples of a few species we caught in our cameras include tayras, pumas, ocelots, a northern tamandua (plus baby northern tamandua riding on its back!), pacas and coatimundis. Hair samples are currently being analyzed, and these samples will help to increase our species list. These data will be used to create a dispersal movement model for the corridor.

Interviews: We logged a total of 11 interviews with landowners and managers. On average, the interviewees reported seeing 19 different species on their properties. And, on average, 25% of the reported species are considered nationally endangered. These data will be used to create the dispersal movement corridor map, and will also be used to model conservation priorities within the corridor.

Vegetation plots: We conducted 61 vegetation plots over a variety of habitats, including, primary forest, forest plantation, sloth plots, ecotourism and reforestation areas. These data will be used to describe habitat, and also to quantitatively describe how vegetation varies within the government vegetation classes used to receive payments in the Payment for Ecosystem Services (PES) program.

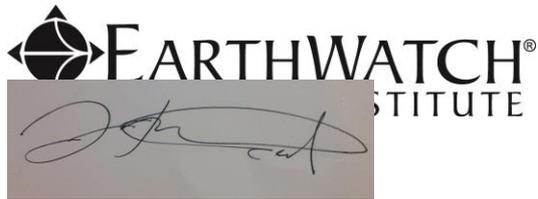
Sloths: Together, we collected data on 37 sloths, some of which were re-sighted up to fifteen times throughout the summer! Despite the rain storms, steep terrain and bug bites galore, we also managed to complete 32 "sloth plots" during which we measured the DBH and tree heights for over 250 trees! These data will be used to determine preferred habitat and vegetation for sloths.

We could not have accomplished this large-scale research project without your motivating help each and every day. We appreciated the early mornings, the hard work during the rainy days, and the wonderful conversations at night after a productive day. With our data we have helped move biodiversity conservation forward in Costa Rica.

Congratulations to us all for a job well done!

Pura vida,

Margot Wood, Thomas Lacher, Kelsey Neam, Eugenio Gonzalez



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Top highlight from the past season

We are astonished to find such a high variety of medium and large mammals throughout Payment for Ecosystem Service (PES) forest fragments in the corridor. Payment for Ecosystem Services properties receive voluntary conservation payments from the government in exchange for protecting private lands. Both interviews and camera traps confirmed that PES lands do hold a diverse array of species. And while some land use types hold higher diversity than others, overall we found species that filled each ecological niche of the food web, from carnivores to herbivores, on almost all properties.

Goals, Objectives, and Results

The three research objectives are stated here:

(1) Conduct a land use change analysis within the biological corridor, focused on Payment for Ecosystem Services (PES) lands versus non-PES lands during the first generation of the tied microtargetted PES policy and the National Biological Corridor program. This will be used to understand changes occurring in the corridor, and can illuminate flexibility in land uses for future potential changes.

(2) Create a dispersal resistance map for the corridor for less-sensitive and sensitive mammal species to identify dispersal corridors and barriers. This will help to determine the impact of PES on corridor creation or sustainability. It will also determine if additional spatial targeting within the corridor can help to alleviate barriers to corridor formation. Also, we will assess species richness and vegetation structure, through forest and canopy cover, in the different PES and non-PES land use treatment categories. This will provide an independent quantifiable vegetation measurement that can help to delineate vegetation functional differences in the land use types.

(3) Assess how future PES land use options and their costs and benefits impact the dispersal corridors and mammalian biodiversity of the corridor. Under this objective, we will take the biodiversity measures from each land use in the corridor, and input other values, such as cost to change land use, value for edge of habitat (ex. hard edge value is



farm bordered by primary forest), to evaluate the overall conservation value of the biological corridor. This will be used to provide regional conservation management recommendations for future PES planning that focus on mammalian communities in the biological corridor.

The progress we have made thus far on the research objectives:

(1) We have collected ground control points and accuracy points for land use change analysis. The land use classification and change analyses are in their final stages, and will be completed within the month.

(2) With regard to the dispersal resistance map, we have collected biodiversity data across the corridor, on both PES and non-PES lands, and bordering protected areas.

(3) Cost data have been collected from government policy documents, NGO documents, and interviews. These cost data, along with the biodiversity data, will be used to parameterize land use, for conservation and land owner cost, across the corridor. Then, this data will provide current conservation status and also allow for modeling future conservation status across the corridor.

Project Impacts

1. Partnerships

We have developed many partnerships over the past three years, including partnerships with FONAFIFO (Fondo Nacional de Financiamiento Forestal, government agency), CODEFORSA (Comision de Desarrollo Forestal, NGO), the National University of Costa Rica, the Soltis Research and Education Center and local land owners. We have partnered with the government agency, FONAFIFO. This partnership is essential for the project as they have access to past and present PES information. This partnership has helped us achieve our goals and objectives by providing Paso de Las Nubes specific PES land use maps, PES participant information and PES payment plan information.

We have partnered with the local NGO CODEFORSA, who coordinates PES policy plans with the local land owners in the Paso de Las Nubes Biological Corridor. This

NGO can provide access to participating landowners. Our partnership with this NGO helped us to achieve our goals and objectives by allowing us access to PES lands for data collection, introducing us to PES farmers and land owners and providing us with historical PES information, specific to the corridor of interest.

We are working directly with the landowners who allow us to enter their lands and collect data. The landowners help us to achieve our project goals by sharing their local ecological knowledge, allowing us to collect data on their lands and lastly, by providing cost and land use information during our interviews.

We have partnered with the Soltis Research and Education Center. They have supported us with scientific permitting, contacts to NGO and government officials, and help with logistical aspects of the project, such as lodging, meals and supplies. They are integral for achieving our goals and objectives through their Costa Rican connections. The Soltis Center has also provided the tools and facilities to our research team, and also by providing general knowledge on the Biological Corridor.

We have partnered with the National University of Costa Rica. We have been collaborating with a Geography undergraduate student, Pablo Castro, for two years. Pablo has been helping us to collect biological data to pair with his geographic data for his senior thesis. His work is focused on mapping the entire biological corridor watershed, including streams, rivers, vegetated areas, etc. This partnership helps to accomplishing our goals by providing a watershed map of the corridor, which will then be used as the basis for understanding corridor and PES interactions. This information is also essential in creating an overall conservation model.

2. Contributions to conventions, agendas, policies, management plans

- **International**

Many of the mammals in the Paso de Las Nubes Corridor are considered nationally endangered in Costa Rica, mainly due to habitat loss and fragmentation. Some species are also considered globally endangered or threatened. The data from this study will provide a conservation action plan for

biological corridors, to enable mammalian population movement and persistence.

This research is important at the international level, to increase the health of the corridor system, which feeds into the multi-national meso-American corridor system. The Meso-American corridor allows for movement of large ranging species, such as the jaguars, pumas, and also provides connectivity for protected areas in the region.

- **National or regional**

Many of the mammals in the Paso de Las Nubes Corridor are considered nationally endangered in Costa Rica, mainly due to habitat loss and fragmentation. We are working with CODEFORSA and FONAFIFO to draft corridor management plans that incorporate mammalian corridor conservation data with the PES policy, to provide a mammalian conservation management plan. We are also submitting our data to CODEFORSA and FONAFIFO, so that they may use the information within their agencies. Lastly, we will be using the data on vegetated movement corridor location to recommend culverts and underpasses along the new highway intersecting the middle of the Paso de Las Nubes biological corridor.

The post research conservation actions include policy recommendations through, (1) corridor identification, (2) scenario modeling to project future land use under the PES program, and (3) analysis of land use and habitat requirements of mammals to facilitate movement and dispersal through future PES incentives. The specific land use component of this study is important as recommendations to FONAFIFO and the coordinating NGOs are already focusing on this land unit in their conservation policies. This will allow for our measurements to fit into land use payments already in place with the PES policy. This research based conservation project will provide measurable habitat and dispersal information for the Paso de Las Nubes Corridor; in the future this technique and methodology can be used with the national corridor system of Costa Rica to provide an overall assessment of the corridor health with regard to mammalian populations. Current PES policy strives to protect biodiversity, but due to limited funding, the policy cannot be evaluated through

the government. With this study, we can assess how PES is functioning on the ground and how to best use conservation funding to target relevant species and communities. Coordination of this research with the PES program allows for the potential to increase mammal diversity by increasing habitat, corridors and genetic flow for the target species. With an increase in mammalian habitat, other species habitats will be created or restored leading to an increase in overall biodiversity and protection for this valuable biological corridor.

- **Local**

This action plan will be important on a local level to improve conservation in this biologically important corridor. Cattle grazing and ornamental plants are large causes of deforestation in this particular region. Providing evidence of mammal conservation on PES lands will show the significance and viability of this policy and also show the importance of conservation funds in the local area. Also, local participating landholders, who have been shown to already value conservation, get to see the evidence of their hard conservation work, through mammal pictures and conservation of habitat for sensitive species.

3. Developing Environmental Leaders

First, we engage the local community by interviewing them on their biodiversity knowledge. Many other studies have shown that mammal knowledge gained from land user interviews is comparable to transect or camera trap data collection. Local biodiversity knowledge gathered from interviews has been directly incorporated into the research design and data. This provides community participation and input to the research.

We engage Earthwatch volunteers by first providing an overview presentation on the study system and then detailing how local land owners have conducted proactive environmental measures to restore the biological corridor. Next, we guided them through field data collection and analysis. At the end of each team, we reviewed the data the volunteers collected and show how this data is used to accomplish the goals of the project. The volunteers learned how to collect scientifically valid data to address research hypotheses. And the volunteers also learned how local Costa Ricans use the land for livelihood purposes. This project

provided the volunteers with a view into rural agricultural regions of the country, and the national policies that aim to help both the environment and the citizens.

We are also engaging undergraduate students through this project. We mentored three students over the course of this field season (and also for the last 2 years), one Costa Rican undergraduate and two Texas A&M University undergraduates. We mentored the Texas A&M students on a small mammal diversity study, and guided their data collection throughout the summer. We are working with an undergraduate student from the National University. We are providing professional mentorship. He has mapped the regional watershed for this senior thesis, and he has plans to use the biotic data from this project to help him parameterize his mapping project.

4. Actions or activities that enhance natural and/or social capital

First, through the project, we provided landholders with property species lists. Many landholders personally asked for this information, out of curiosity, and some wanted the information to help start ecotourism activities on their lands. These species lists help people to market their properties and understand the types of species present. Along with the species list, the pictures of the species were used by the property owners as proof of their dedication to protection and conservation.

Second, there has been a recent fear of large cats, namely, pumas and jaguars, in the region. During interviews with land holders, when concerns, fears or complains were leveled against large cats, we had an informal discussion on the importance of these large predators to the ecosystem. We also discussed how to protect livestock and horses from attacks by large cats. We are continuing the efforts already in place at the Soltis Center to educate and inform the community about living with large predators. This is an essential part of the project, as increased habitat in the corridor will lead to an increase in wildlife. The communities must be provided with information on how to accommodate this increase. This information and education will hopefully decrease human-wildlife conflict that could undermine the PES program.

5. Conservation of Taxa

This project enhances and maintains mammalian taxa. This project delineates corridors for mammal species of conservation significance in the Paso de Las Nubes Corridor. By addressing and delineating these corridors, land uses and corridors can be targeted and conserved through PES program actions. This will increase corridor connectivity and conserve habitat for the mammal community. Because this project focuses on policy, direct species recommendations can be made to the government and NGO actors to facilitate species conservation. Also, wide-ranging mammal species specifically benefit from habitat conservation and connectivity as they require large connected habitats.

This study also addresses mammalian species richness in the corridor. The absence of particular species can be used to motivate additional resources to increase availability and quality of favorable habitat. For example, if a species is conspicuously absent in the corridor, this can prompt additional inquiries into hunting practices, disease or overexploitation. If target mammal species are not found in the corridor, PES efforts can be re-directed to connect isolated populations.

Over the summer we recorded instances of over 25 different mammal species. Please see the attached species lists in the appendix to view the specific taxa studied over the field season. There are two tabs on this list. One tab provides the species list from interviews and the second tab shows the species list compiled from camera traps. This list includes IUCN status and national status of the species recorded. This study is helping to maintain habitat for these species by providing tangible data on the conservation value of the PES payment receiving lands.

6. Conservation of Habitats

Natural habitats are essential for mammalian population persistence and corridors, and encompass the majority of the PES payments in the study corridor. These habitats need to be spatially aligned to provide the best corridor network for the target species of interest. This project enhances and maintains natural habitats (cloud forest, montane rainforest) through study of PES payment of these privately held lands. The Paso de las Nubes Biological Corridor encompasses approximately 40,000 hectares of privately held lands.

Coordinating where additional natural habitat is needed will more efficiently target PES payments to increase corridors. Also, through the biodiversity data collected this summer on (1) primary forest and planted forest lands, this data will help to prove the importance of these payment lands with the goal of securing future funding for PES conservation efforts. Lastly, PES payments target both sustainable use and natural habitats; natural vegetation functions more effectively as habitat when present without edge effects. This requires borders between land use types to be soft rather than hard. The sustainable farming payments help to decrease the contrasting borders of the land uses in the biological corridor. For example, a hard border of clear cutting along a primary forest can cause increased fires, vegetation destruction and differing climate, miles into the primary forest. Avoidance of these harsh borders is a goal of the PES program, to provide buffer zones along each National Park.

7. Ecosystem Services

This project is helping to restore and maintain ecosystem services. The main goal of the PES program in Costa Rica is to pay individual landowners for ecosystem services that will benefit overall wildlife and human well-being. Assessing the effectiveness of this program will allow for more efficient targeting of investment based on scientifically collected data. With targeting, PES payments can increase corridor area and effectiveness by fortifying existing corridors, while providing additional habitat. Along with corridors, the goals of these payments include water and biodiversity protection, scenic beauty enhancement and carbon sequestration. Each of these goals provides ecosystem services from the natural world to Costa Rica and to the global society. Specifically, payments for vegetation or forested areas help to sequester carbon, which is important globally in climate change. Also, many of the citizens of Costa Rica rely on clean streams for drinking water. With payments for vegetated habitat and sustainable agriculture, upper watersheds, including the watershed in the Paso de Las Nubes corridor, will be protected and continue to provide water to the Costa Rican citizens downstream.

8. Conservation of Cultural Heritage

This project helps to enhance cultural heritage as landowners participating in the PES program are paid to continue sustainably using lands, while at the same time

gaining benefits from the wildlife and ecosystem services. Costa Ricans value their country's biodiversity and natural landscapes, as indicated by the national conservation efforts and overall conservation sentiments. This project will help to preserve Costa Rica's natural heritage, while allowing this preservation to be financially feasible for landowners. The sustainable use and monetary aid for these landowners will permit generations of Costa Ricans to produce and live from these lands.

Almost all farmers interviewed were enthusiastic about ecosystem preservation and biodiversity conservation. This project is providing the opportunity for the farmers, landowners, government officials, NGO agencies and researchers to collaborate on the ground while working towards a common cultural goal: conservation. These various actors all share their cultural heritage, but rarely interact. This project opens a dialogue focused on national biodiversity and livelihoods, and how these two seemingly separate goals can coexist and thrive in the biological corridor.

9. Impacting Local Livelihoods

This project contributes to enhancing and maintaining livelihoods in the community within the Paso de Las Nubes Biological Corridor by working with the landowners to best understand their needs from the PES system, and to recommend policies that benefit both landowners and the ecosystem. The local residents are already seeing enhanced livelihoods through payments that supplement their current income, while at the same time, providing benefits to the ecosystem. Sustainable landscapes and corridors cannot be formed without local involvement and benefit. This program allows for alternative, less intensive use of the lands. This can provide families and communities with added income. Tied to this additional income is education on how to sustainably manage lands, which can be disseminated from PES participants to friends and neighboring communities, who witness the benefits of sustainable land use. The PES project insures that the communities in the corridor, and downstream, have a protected, reliable water source, which monetarily is a very expensive natural commodity.

10. Local community activities

Community members are an integral part of our research. Every person that we contacted was very excited about the research and the project. Each person contacted chose to participate and allowed us to place camera traps and hair traps on their lands, and also to conduct vegetation measurements on their properties. We were very appreciative for the warm reception.

While working with the community in the Paso de Las Nubes corridor, we provided updates on camera traps and dates when we would be visiting the properties. We invited property owners and property managers to join in setting and checking the hair and camera traps. We also asked them about the best locations to place the traps on the property. Lastly, we interviewed land managers to ask their ideas about conservation, the future of the biological corridor and biodiversity information on their property.

At the end of the field season, we provided each land owner with pictures of the species on their lands, and described the work accomplished over the summer. In December, we provided them with a translated corridor level summary of the data collection results.

11. Scientific peer-reviewed publications

Future planned publications:

1. Land use change analysis of corridor before and after corridor delineation law in 2006
2. Do PES lands overlap with vegetated areas creating movement corridors? Movement resistance mapping.
3. Conservation potential of the Paso de Las Nubes Biological Corridor, Marxan plus zones Model

12. Grey literature and other dissemination

Lecture: I lectured to the Conservet group about the research in June 2014.

This group is comprised of veterinary students who are interested in the combining of conservation and veterinary work to solve ecological problems.



Lecture: I lectured to Dr. Don Brightsmith's study abroad course, Biomedical Abroad Semester. This course is composed of biology and wildlife and fisheries science students from Texas A&M.

I will be presenting this work in the following conferences in 2015: George Wright Society, Conservation Biology, Parks for Science, Science for Parks Conference

Lastly, after the end of the field season, we acquired email addresses for all land owners and managers from the project. We sent emails with an abbreviated summary of the research, and also provided each person with pictures of mammals found on their property.

Acknowledgements

We would like to thank the Soltis Center and Eugenio Gonzalez for providing wonderful housing and logistical support over the field season. We would also like to thank Heather Pruiksma for her guidance and advice through our first field season. Thank you to our undergraduate students, Lili, Becca and Pablo who worked tirelessly on their projects, as well as on our research project, and continually remained excited about research and the tropics. Lastly, we want to thank Kelsey Neam for being a wonderful impromptu team leader and research partner over the summer.