Dear Earthwatcher,

Thank you for all your efforts at The Rainforest Project, Puerto Rico!

We highly appreciate your decision to come here and help us accomplish our goals towards sustainable management of this forest. With the data we have been gathering we are able to evaluate the needs and direction of further studies, and implement relevant strategies and management plans. The more we learn, the more we know, the more we can do.

The 2008 season involved a total of seven Earthwatch teams, including two teenage teams, and two family teams, to help conduct comparative thinning studies within Mahoe and Mahogany plots, agro-forestry experiments with coffee-planting and Artemisia, along with vine identification, and lizard studies. Each group also participated in night-time frog studies.

In helping to achieve our research objectives, the data collected by Earthwatch volunteers has helped to create essential, collaborative inroads. The Department of Natural Resources, The USDA, and International Institute of Tropical Forestry have become increasingly interested in the project's work over the last year and have visited, and got to know us better.

In a recent meeting at the DNR about Forestry Management, Director of the Forest Bureau, Edgardo Gonzáles, put the completion of the Tropic Ventures Sustainable Forestry Management Plan as a priority by the end of 2009. The project becomes a demonstration in new models for approaches to forest management in Puerto Rico and the Caribbean. Frank Wadsworth, eminent forester, has been key in helping this along, aware of our unique collaboration with Earthwatch. All of our silviculture methods and data collected in the field will be part of this important document.

With our data, we have also presented our project's objectives and results in seminars to students at the University of Puerto Rico. Doing so has encouraged Prof. Jim Ackerman, an eminent botanist in PR, to make regular visits to collect herbarium specimens, with his students in taxonomy.

We are also pleased to announce that our first research paper ***"The Impact of Hardwood Line-Planting on Tree and Amphibian Diversity in a Secondary Subtropical Wet Forest of Southeast Puerto Rico"*** has been accepted for publication in the Journal of Sustainable Forestry, Volume 29, Spring Issue 4, 2009.

Once again gracious thanks from all of us here, this is not easy terrain to work in, with the steep slopes and mud, but teamwork and the love of nature counts for everything. It has been wonderful to get to know so many people from all over the planet! We salute you all. Please come and re-visit us in the future, and keep up to speed on the work we are doing by checking into the website and newsletter. www.eyeontherainforest.org

High Regards,

3t, Mark, Andrés, Molly, Joe, Briony, Bridget and Norman
(and the dogs, cats, chickens and horse!)

EARTHWATCH INSTITUTE ANNUAL FIELD REPORT

Project title: **Puerto Rico's Rainforest**
Date completed: **23rd January, 2009**
Completed by: **Thrity Vakil**
Period covered by: **April 2008 to 17th Jan 2009**

Research report

Objective 1: To examine the effectiveness of thinning techniques in our current plantings of Mahoe and Mahogany.

In March 2008, 19 mahogany trees were thinned in an experimental study in a quarter acre plot with a total of 50 mahogany trees. Along with an adjacent control plot, data was collected on the impact of this thinning by Earthwatch volunteers.

During 2008 we were able to set up five new tree study plots for our thinning study. These five plots together contained close to 150 trees. All the trees in the plots were measured once in January 2008 and summer 2008 and then a second reading was taken for two of the plots in December 2008.

Without the help of EW volunteers we would not be able to measure such a large number of trees as quickly as it is a very time consuming process. This is the first year that we have obtained one year growth data for any of our trees. Previously our study plots have only been measured ever two to three years.

Objective 2: To evaluate commercially valuable crops that can be grown in conjunction with the line planted mahogany.

Coffee

101 plants of *coffea arabica* were planted in 2008, in mahogany plantation areas. The study was consulted by Edrick Marrero, agronomist and coffee expert at the Adjuntas Agricultural Extension Station that collaborates with the University of Puerto Rico in Mayaguez. Approximately 10 oz of cow-manure and 3oz of limestone were applied in the plantings. Measurements were taken on all the plants and data collected regarding conditions of the plants' leaves and stalks, and apparent diseases, fungi and others. The plants will be constantly monitored.

Artemisia

The objective with this study is to carry out trials to see if this commercially valuable plant will flourish and produce adequate artemisinin content under the conditions at Las Casas de la Selva. Artemisia seedlings were raised in the nursery and at around 15cm high, early seedlings transplanted with the help of Earthwatch volunteers, and a total of 267 plants were planted out in the field on three different plots. A sample of leaves has been sent to Cayey University of Puerto Rico, for testing. More Artemisia will be planted in 2009.

Objective 3: To evaluate populations of the lizards of the genus Anolis at Las Casas del la Selva and monitor the effect of habitat disturbance due to line planting and tree thinning activities.

The Anolis spp. count at Las Casas de la Selva has been expanded to include 5 areas of 6 plots each, for a total of thirty plots. These plots cover such diverse micro-ecosystems as coffee plantation, second growth forest, fern tree stands, clearings, Caribbean Pine groves, and Mahoe plantations. The EW volunteers were instrumental in the expansion of the study, helping to mark out new areas for counting.

The count itself yielded valuable information. Based on preliminary data, it can be said that Caribbean Pine monocultures provide poor habitat for anoles (a family of lizards), with this area being the least populated of all the areas studied. The shade-grown coffee plantation yielded several dozen specimens of *A. stratulus*, along with several *A. gundlachi* and *A. cristatellus cristatellus*. This may be due to the numerous basking and hunting sites created by leaving in several trees in an open fashion that allows sunlight to penetrate to the forest floor (but further study is required to confirm this).

Objective 4: To evaluate the availability and abundance of non-timber forest products that are of economic importance on the property, commencing with vines which are a source for fiber used in weaving and handicrafts.

The initial assesment of vine species and abundance was completed in 2008. If we ascertain that there is a significant abundance of species that could be put to commercial use we will carry out the growth studies in 2009. Preliminary surveys were conducted in May, June and July and December of 2008, during which all vines and lianas were identified and recorded at two sites in $100m^2$ plots.

Because of their durability, resistance to decay, and large diameter, woody vines and lianas appear to be more useful than herbaceous vines as secondary forest products.

Of the 353 vines and lianas counted in fourteen $100m^2$ plots ($1400m^2$ total), 76 were lianas and 75 were woody vines (as defined by Acevedo, (2005), accounting for 42% of the total population. *Hippocratea volubilis* accounted for 12% of the total individuals found, making it an excellent candidate for further study. Other good candidates include *Pinzona coriacea* (4% of individuals), *Securidaca virgata* (6% of individuals, as well as over 200 seedings found), *Fosteronia portoricensis* (4% of individuals), and *Paullinia pinnata* (4% of individuals).

The species curves for plots 114 and 85 show a great decrease in the number of new species found after two $100m^2$ plots. A more liana-specific survey will continue, and growth rate assessment will begin in mid 2009. The forest will be further surveyed for liana species and abundance in order to better determine which species may be useful and plentiful, as well as to create baseline data which could be used in the future to track the health of lianas in the forest as a whole.

Growth rates will begin to be assessed for species of particular abundance and commercial interest. There has not been much work done on the measuring the growth rate of tropical vines. This will be important for future assessment of the rate at which we could sustainably harvest vines of economic importance from the forest.

Project development

Vine Study Modification

After starting the initial species curve study of the vines at the project, we have modified the original proposal. Now that we have had a chance to learn more about the vines, by identifying them, we can move toward the study of specific vines that may be useful economically.

New Objective 1: To examine the effectiveness of liberation thinning on maturation and volume of tree crops in secondary forest areas.

Most of the land at Las Casas de La Selva, Patillas, Puerto Rico is secondary forest, formerly used for coffee plantation and other small farming operations. Some 350 acres of the thousand acre property were line-planted with valuable hardwoods, primarily mahogany and mahoe from 1985-1989. Areas of the line-planted plantation that have poor mahogany or mahoe trees contain many other marketable tree species, such as Tabonuco (*Dacrodyes excelsa*), Ausubo (*Manilkara bidentata*), Roble blanco (*Tabebuia heterophylla*), and Maricao (*Byrsonima spicata*). Larger individuals of these species were left untouched when line-planting was done on a portion of the land. Research has indicated that methods of management to reduce competition from nearby trees and trees which overtop the canopy of commercially valuable native and planted trees can dramatically speed up the growth of these trees, leading to reduced time to harvest and increasing the amount of marketable wood produced. These forestry management techniques offer a way to sustainably increase economic viability from secondary forest.

Such research could be widely applied, as an increasing percentage of the land in Puerto Rico consists of such forest (Brandeis et al. 2007), which is generally thought to be unworthy of silvicultural treatment because of the excessive time it takes for commercial trees to develop to harvestable size with the unrestricted tree density and competition in unmanaged secondary forest. (Wadsworth, 1987).

Expected results include increase of dbh (diameter of a tree at breast height, or 4.5 feet) and basal area (cross-sectional area of a tree at breast height) /density of crop species per hectare compared with control plot trees.

The liberation technique will be deemed to have had a measurable impact if the productivity increases are statistically significant in the experimental (thinned) plots and a success if these increases make the methodology economically valuable in speeding maturation and increasing marketable wood. By comparing the crop trees liberated in the experimental plot with those in the control plot we will be able to calculate the volume increase that would have been gained had the competitor trees been left in place compared with the volume increase gained as a result of liberation.

It is estimated that the study will take 3-5 years to complete, with initial measuring and thinning taking place in year one and follow up measurements being taken in subsequent years by Earthwatch volunteers. Following crop and competitor tree growth over a period of 3-5 years will allow us to see trends in development which shorter studies do not permit.

Summary of results

Data collected, results and emerging trends

Thinning study:

In March 2008, 19 mahogany trees were thinned in an experimental study in a quarter acre plot with a total of 50 mahogany trees. Along with an adjacent control plot, data has been collected on the impact of this thinning by Earthwatch volunteers.

During 2008 we were able to set up five new tree study plots for our thinning study. These five plots together contained close to 150 trees. All the trees in the plots were measured once in January 2008 and Summer 2008 and then a second reading was taken for two of the plots in December 2008.

Without the help of EW volunteers we would not be able to measure such a large number of trees as quickly as it is a very time consuming process. This is the first year that we have obtained one year growth data for any of our trees. Previously our study plots have only been measured ever two to three years.

Lizard study:

The EW volunteers were instrumental in the expansion of the study, helping to mark out new areas for counting. The count itself yielded valuable information. Based on preliminary data, it can be said that Caribbean Pine monocultures provide poor habitat for anoles, with this area being the least populated of all the areas studied. The shade-grown coffee plantation yielded several dozen specimens of *A. stratulus*, along with several *A. gundlachi* and *A. cristatellus cristatellus*. This may be due to the numerous basking and hunting sites created by leaving in several trees in an open fashion that allows sunlight to penetrate to the forest floor (but further study is required to confirm this). The EW volunteers were sharp and quick, and I am under the impression that every single anole was counted during their visit.

Vine study:

Preliminary surveys were conducted in May, June and July and December of 2008, during which all vines and lianas were identified and recorded by Earthwatchers at two sites in $100m^2$ plots. 353 vines and lianas counted in fourteen $100m^2$ plots.

Artemisia study:

A total of 267 plants were planted out in the field on three different plots. A sample of leaves has been sent to Cayey University of Puerto Rico, to test for artemisinin content.

Coffee study:

101 plants of *coffea arabica* were planted in 2008, in mahogany plantation areas. The study was consulted by Edrick Marrero, agronomist and coffee expert at the Adjuntas Agricultural Extension Station that collaborates with the University of Puerto Rico in Mayaguez. Approximately 10 oz of cow-manure compost and 3oz of limestone were applied in the plantings. Measurements were taken on all the plants and data collected regarding conditions of the plants's leaves and stalks, and apparent diseases, fungi and others. The plants will be constantly monitored.

Contribution of result to achieving conservation impacts

The data collected by Earthwatch volunteers helps us plan our future work at Tropic Ventures. We will use the study to make long term strategies to ensure continuous production and regeneration of hardwoods without adversely affecting the ecology, and offer the benefit of our experience to others who are looking for sustainable ways to utilize rainforest land.

The project site is still under evaluation to see if it will be suitable for the release of the Puerto Rican Parrots that have been raised in captivity. This is a very rare and endangered bird and the data we have gathered so far will help to establish if we have tree species suitable for the birds.

The project has held approximately 800 hectares of rainforest land as a wilderness preserve for the last twenty-three years. This area is undisturbed apart from minimal access for scientific investigation and hiking. Two of the watersheds that feed Lake Patillas (the local reservoir) are in this area. Demonstrating that this type of terrain can be used economically without clear-cutting it or destroying the ecology may encourage conservation of similar areas.

Communication of results

Printed:

Our first research paper ***"The Impact of Hardwood Line-Planting on Tree and Amphibian Diversity in a Secondary Subtropical Wet Forest of Southeast Puerto Rico****"* has been accepted for publication in the Journal of Sustainable Forestry, Volume 29, Spring Issue 4, 2009.

Our next paper ***"Performance of line planted Mahogany and Blue Mahoe in Puerto Rico. An investigation for sustainable forestry management & hardwood production",*** is currently being edited for publication. Kelly C. Reiss, Center for Environmental Policy, Environmental Engineering Sciences, University of Florida is working on the statistical analysis of our data.

Visual:

Powerpoint Presentation by 3t Vakil for use at the project detailing Earthwatch volunteer research work, as well as all other project activities.

3t Vakil, continues a life-long pursuit of painting at the project, and all of the forestry research finds its way into an ongoing series started in 2006 entitled "Eye On the Rainforest". Becoming a forester, collecting data, understanding the data, and the realisations of the importance of secondary forest management and sustainable timber production are all captured on large detailed canvases. www.eyeontherainforest.org/wanderwoman3t.php

Digital:

Website: www.eyeontherainforest.org
Newsletter: http://www.eyeontherainforest.org/rfnewsletter212008.php

Mass media:

Television & Radio Interviews

Nov 08 Susan Soltero – Univision TV
Nov 08 Radio Isla

Magazine articles

'**Geographical**' September 2008, editor Geordie Torr's informative article on a 2007 Earthwatch Expedition at Las Casas de la Selva.
'**Alter-Nativo'** May-July Vol.1 #2 2008
**'The Journal of American Woodturners', ** Spring 2008, Article by environmental advocate Brad Whitman.

Meetings and conferences

Public presentations given & attended

Nov 08 ***"Out of the Lab"*** seminar and digital presentation by 3t Vakil, Natural Sciences, UPR, Rio Piedras.

Nov 08 ***"Tree Talk"*** presentation by Andrés Rúa at Thomas Armstrong School, Ponce.

Oct 08 **Programma de Manejo de Bosques Privados de PR (Counsel for Private Forestry Management in PR),** DNRA Headquarters, Rio Piedras.

Sept 08 ***"Project Ecotropolis"*** presentation and discussion to the community by DRNA , at Forest Office, Carite National Forest. Future ideas for the obsolete prison (campamento) on the 184 in Carite.

Sept 08 ***"Puerto Rico Forest Inventory & Analysis"(FIA)*** Presentation & discussion: Edgardo Gonzalez, DRNA, and Humfredo Marcano Vega, USDA, & University of Puerto Rico, Cayey.

June 08 ***"Eco-Ideas"*** conference and presentation by 3t Vakil & Andrés Rúa at The Interdisciplinary Institute**,** *Instituto de Estudios Interdiciplinarios*, UPR, Cayey, This presentation was specifically for professors interested in collaborating with us on a field forestry curriculum, which at present does not exist in Puerto Rican Universities.

June 08 ***"Biospherics"*** presentation by Johnny Dolphin**,** El Teatro, Las Casas. Public Event.

"Tropical Forest Recovery at Multiple Spatial Scales" by Dr. Maria Uriarte, Instituto de Estudios Interdiciplinarios, UPR, Cayey.

April 08 ***"Tropic Ventures Sustainable Forestry"*** presentation by Andrés Rúa at The General Electric Company, Patillas.

Dec 08 ***"Vetiver"*** presentation by Alberto Rodriguez, Las Casas for Earthwatch volunteers.

Educational Opportunities

Involvement of different groups in the research topic

Local communities:

The project employs local labor whenever necessary in forestry related work, and for harvesting, hauling and sawing of wood. It is important that local people really understand what this project is demonstrating with regards to sustainable forestry management practice, its potential economic benefits, erosion control on steep slopes. Local artisans are employed to make quality items for sale using our sustainably harvested Blue Mahoe Hardwood.

Students:

Students of Botany, Taxonomy, and Biology from University of PR are collecting and identifying specimens at the project for the main Herbarium in PR.

Early career scientists:

Jon Every, an ex-Earthwatcher is now President of the University of Reading Botany Society, UK, works with the Kew Garden Herbarium, and has helped with specimen collection, identification and plant propagation. He continues to participate as a *satellite* botanist.

Other groups:

Frente Ambiental, Amigos de la Naturaleza, Patillas.

Helping different group understand and act towards the conservation of a sustainable environment

Rainforest enrichment provides watershed protection (the local reservoir – Lake Patillas is becoming increasingly silted). Project staff member, Andrés Rúa, is making a clean-up of this lake an annual necessity with the local community of Patillas, along with volunteers from Las Casas de la Selva. In addition, project volunteers instigate and take part in beach and river clean-ups.

Demonstrating that this type of terrain can be used economically without clear-cutting it or destroying the ecology may encourage conservation of similar areas. Part of the educational message of the project is water purity. A Wastewater Garden (subsurface flow constructed wetland, planted with a diversity of tropical wetland species) onsite ensures that no polluted water from the homestead is contaminating ground or river water. All visitors are made aware of this treatment of their waste water, and are inspired, we hope, to create these gardens as part of sustainable communal living.

Erosion control. Our project is an excellent illustration of the necessity to keep the steep slopes of the local terrain covered in trees. Clear-cut areas just off the borders of our property show signs of deep erosion gullies and land degradation. In September 2008, a tropical depression dropped 33 inches of rain in 5 days. The extent of landslide damage originating in grazed and clear-cut slopes was obvious. The project offers an alternative approach to use of this type of terrain.

Acknowledgements

Mark Nelson, Thrity ‘3t’ Vakil, Sally Silverstone, Molly Robertson, The Institute of Ecotechnics, Andrés Rúa, Briony Plant, Bridget McNassar, Norman Greenhawk, Patty Boyko, Joe Sarquillla, Kelly C. Reiss, Pamela Medina, Frank Wadworth, Peter Weaver, Pedro Acevedo, past, present and future Earthwatchers, Rafael Joglar, Patricia Burrowes.