

# EARTHWATCH INSTITUTE FIELD REPORT

**Earthwatch Institute Mission:** *Earthwatch engages people worldwide in scientific field research and education to promote the understanding and action necessary for a sustainable environment.*

**Project Title:** Puerto Rico's Rainforests

**Principal Investigator (s):**

- a) Sally Silverstone
- b) Dr. Mark Nelson
- c) Dr. Rafael Joglar
- d) Dr. Patricia Burrowes

**Position/Affiliations:**

- a) President, Tropic Ventures Education and Research Foundation. CFO and V.P. Agriculture and Forestry Biosphere Foundation
- b) Chairman, Institute of Ecotechnics
- c,d) Proyecto Coqui; University of Puerto Rico, Rio Piedras Campus

**Research Site(s)** (geographic location, include coordinates if known, e.g.

**Lat/Long):**

Las Casas de la Selva, Patillas, Puerto Rico

**Local Management Status of the Research Site(s)** (e.g. National Park, RAMSAR Site, World Heritage Site, IBA etc.):

Department of Natural Resources Auxiliary Forest.

**Scientific names of primary species being studied (if appropriate):**

Mahogany (*Swietenia macrophylla*)

Mahoe (*Hibiscus elatus*)

**Frogs:**

Common Coqui (*Eleutherodactylus coqui*)

Melodious Coqui (*Eleutherodactylus wightmanae*)

**Key Research Objectives:**

Research into economic and ecological use of rainforest lands.

**Examining effectiveness of line planting techniques for tropical hardwoods.  
Looking at effect of line planting techniques on overall biodiversity of forest.  
Studying local Coqui populations and possible effects of line planting on Coqui populations.  
Evaluating native hardwood timber stands**

**Date this report was completed:**

**April 18<sup>th</sup> 2007**

April 18<sup>th</sup> 2007

Dear Earthwatch Volunteers,

I am writing to thank you all so much for your work at las Casas de la Selva this year. It was a really busy and productive year in all ways and we really appreciate the fact that you all gave up your spare time to come and join us in this research effort.

We have made a really good start on our native hardwood study and will be able to complete this in 2007. The study will give us an excellent catalogue of our forest species and enable us to evaluate the extent to which we have enriched the area with our own line plantings. Your continued monitoring of our new seedling plantations will help us to decide which trees to use in future plantings.

You will be happy to hear that the blue Mahoe wood is becoming very popular and we are getting orders from artisans in Puerto Rico, United States and Europe for this beautiful and sustainably produced wood. Don't forget to check out our web site at [www.eyeontherainforest.org](http://www.eyeontherainforest.org) to see some of the exquisite products that these artisans are making. This is particularly satisfying for us as we feel that finally the project has come full circle and we are able to show that it is possible to use this beautiful rainforest biome profitably without having to destroy it in the process. If any of you are not getting our regular newsletter updates, send your latest E Mail address to [3t@eyeontherainforest.org](mailto:3t@eyeontherainforest.org).

Next week on Earth Day Andres will be making a radio presentation on an island-wide radio service. This is our first Radio broadcast about the project and we are very excited.

Pamela also sends her many thanks for the help you gave on her study of the melodious Coqui. She hopes to complete her thesis in 2007.

We wish you all the very best, and don't forget that if you are ever in Puerto Rico again you would be most welcome to come on up and see how we are doing.

Regards,

Sally, 3T, Andres, Molly and Jo (and of course Selva, Muppo and Kailash the cat)

## Data Collection and Results

a) Give a concise account of the data you have collected during the past field season.

Coqui study.

This year volunteers visited our main study transect 8 times, four times during the summer and four times during the winter season. A second transect set up for the monitoring of the grass coqui

*E. brittoni* was visited once in the summer and twice in the winter. In all there were over 1,800 sightings recorded. In addition volunteers assisted Pamela Medina, a graduate student of Raphael Joglar with her behavioural studies of *E. wightmanae*. This is a species that we have in unusual abundance on the site, and about which little is known in terms of their behaviour patterns.

Tree studies.

The main thrust this year was the study of our native hardwoods. The volunteers returned to six of the plots already set up to study Mahogany and Mahoe, and took data from the native hardwood trees over 15 cm in diameter. They also assisted in collecting specimens where in-field identification was not possible, and with re-establishing plot borders where these were becoming unclear due to deterioration of flagging. In all, data was taken from 335 trees.

Two Mahoe plots were measured to take more detailed data on actual commercial heights. This data will be used to help put together a plan for thinning. In all, 259 trees were re-measured.

Six small mahogany study plots last measured in 2004 were re-measured to get short-term growth data. In all, 148 trees were measured.

Three of the new native hardwood plots were re-measured. In all, data was taken from 105 trees.

A new study plot containing 50 mahoe seedlings were established at spacing approximately half that of previous plantings. This will be studied to see whether or not closer spacing in the initial planting prevents unwanted side branching of the trees.

b) What progress have you made towards achieving your original objectives?

Progress has been good this year and it seems that barring extremely wet weather we should be able to complete the native hardwood study in 2007 as well as establishing some more small Mahoe study plots on East and west facing slopes for comparison with our south facing plots. This will then complete this phase of our tree research.

c) Please provide a summary of your results (even if they are preliminary).

For Coqui study please see attached preliminary report from Pamela Medina. Pamela will be completing her masters thesis in 2007 and a full report should be available after that date.

#### Hardwood study

In the eight 1 acre plots measured to date, 17 significant hardwood species have been identified to date. The most numerous being:

<i>Micropholis guayanensis</i>	49 trees
<i>Dacryodes excelsa</i>	46 trees
<i>Casearia arborea</i>	17 trees
<i>Buchenavia tetraphylla</i>	15 trees
<i>Sloanea berteriana</i>	12 trees
<i>Manilkara bidentata</i>	12 trees
<i>Ormosia krugii</i>	9 trees

This data is preliminary as several species have yet to be identified. When data on all plots has been collected, a comparison of wood volume of the native species with the wood volume of the line planted trees will be made.

As well as giving us data on the overall composition of our forest, this study will also enable us to compare the economic importance of the native species with that of our planted crops.

#### **Significance/Benefits of Research**

a) What is/are the significance/benefits of your research at the following levels?

- local (in the area of the research site)
- national
- international

(For example, do your findings, or do you expect your findings will contribute to management strategies or biodiversity conservation action plans at any of these levels?)

On the local level we expect our findings to form the basis of future management plans for the project, which has the overall aim of demonstrating sustainable use of tropical forestland. (see below) We are currently carrying out the first stages of harvesting and replanting, and in all of the activities we will benefit from the knowledge gained from this study. Our finding so far have also encouraged us to diversify our planting in the future, seeking other shorter term crops that can be grown under the canopy and that can provide some income more rapidly than the hardwoods.

On the level of our local community in Puerto Rico, the teams of Earthwatch volunteers that come through every year have certainly raised local interest in what we are doing and our neighbours have frequently been invited up to meet and integrate with the volunteers. Our numbers of visitors has increased in 2006, these have included local artisans, farmers, forestry workers and other members of our local community who run

an environmental action group aimed at protecting areas of concern in Patillas. We have started to carry out day visit programs and overnight camps for a local Boy Scout troop. In April 2007 we will be making a radio presentation about the project on Radio Isla. In the summer months we host volunteer groups who carry out community projects locally.

In previous years we have organised workshops in sustainable use of small diameter woods and construction of wastewater gardens. In early 2007 we hosted a workshop for the USDA to train and certify forest fire-fighters in safe use of chainsaws and directional tree felling techniques. As our interaction with the local community grows so will awareness of our work and of the value of Puerto Rico's rainforest resources.

Thanks to the generous Earthwatch sponsorship towards a communications upgrade, TV now has 24 hour online access. This has increased our resources regarding research work, and has increased our level and ability to send information out. Our website is constantly maintained and upgraded with news of all our forestry activities, and science and ecology studies.

On an international level it is important that a project such as this, is visible, and staff easily contactable.

Our website is linked to many other forestry organizations and rainforest related websites. This has also allowed us to send out a quarterly newsletter, informing of activities, research, and encouraging volunteers and students from all over the world to interact with us. [www.eyeontherainforest.org](http://www.eyeontherainforest.org)

We plan to circulate our findings to relevant journals and other rainforest groups and related institutions so that can benefit from what we find and learn from our mistakes.

b) How do your findings contribute to issues of sustainability?

Demonstrating sustainable use of tropical forest land is the overall goal of our project. We are experimenting to find practical solutions to the problem of reconciling peoples need to recover material resources from the terrain with the need to preserve the ecology of the area to prevent top soil loss, species loss, erosion, silting of rivers and lakes and degradation of the biome.

We now know that it is possible to employ this line planting technique to provide a viable alternative to landowners making potentially irreversible decisions that may involve destroying rainforest lands forever along with devastation of watersheds from erosion and impacts on the carbon cycle. A final evaluation of this method as a model for sustainable forestry will result when trees have been harvested and the wood and products successfully sold.

### **Dissemination of Results**

a) Have you provided details of results from your research to or within:

- Scientific papers (indicate status; e.g., peer reviewed or in progress/press)
  - Please provide full references

Amphibian papers to which data collected at Las Casas has contributed:

Joglar, R.L. and P. A. Burrowes. 2005. Status of Amphibian Populations in Puerto Rico - Greater Antilles Region Progress Report. Froglog 72: 1-2.

Lips, K, P. A. Burrowes, J. Mendelson, and G. Parra-Olea 2005. Amphibian Declines in Latin America: Widespread Population Declines, Extinctions and Impacts. Biotropica 37(2):163-165.

Lips, K, P. A. Burrowes, J. Mendelson, and G. Parra-Olea. 2005. Amphibian Population Declines in Latin America: A Synthesis. Biotropica 37(2): 222-226.

Mendelson Joseph R. III, Karen R. Lips, Ronald W. Gagliardo, George B. Rabb, James P. Collins, James E. Diffendorfer, Peter Daszak, Roberto Ibáñez D., Kevin C. Zippel, Dwight P. Lawson, Kevin M. Wright, Simon N. Stuart, Claude Gascon, Hélio R. da Silva, Patricia A. Burrowes, Rafael L. Joglar, Enrique La Marca, Stefan Lötters, Louis H. du Preez, Ché Weldon, Alex Hyatt, José Vicente Rodríguez-Mahecha, Susan Hunt, Helen Robertson, Brad Lock, Christopher J. Raxworthy, Darrel R. Frost, Robert C. Lacy, Ross A. Alford, Jonathan A. Campbell, Gabriela Parra-Olea, Federico Bolaños, José Joaquín Calvo Domingo, Tim Halliday, James B. Murphy, Marvilee H. Wake, Luis A. Coloma, Sergius L. Kuzmin, Mark Stanley Price, Kim M. Howell, Michael Lau, Rohan Pethiyagoda, David B. Wake. Mitigating Global Amphibian Extinctions: Policy Changes and Action are needed. Submitted to the Policy Forum section of Science in April, 2006.

Tree study papers:

Silverstone, Sally, Mark Nelson, Patricia Burrowes, Rafael Joglar, Molly Robertson, and Thrity Vakil. The Impact of Hardwood Line-Planting on Tree and Amphibian Biodiversity in a Secondary Rainforest of Southeastern Puerto Rico. Submitted for publication to The Journal of Sustainable Forestry. (Copy of final paper attached)

S. Silverstone, Dr. M. Nelson, Thrity Vakil, Molly Robertson. Performance of mahogany (*Swietenia macrophylla* x *S. mahagoni*) and blue mahoe (*Hibiscus elatus*) in line planted plantations in the wet forest life zone of the mountains of south eastern Puerto Rico. A preliminary study, for the purposes of sustainable hardwood production management. – In progress.

- Management plans and reports (in progress or completed)
  - By who, for whom, and used by which agencies

The Department of Natural Resources has recently initiated the compilation of a comprehensive Sustainable Forestry Management plan for the future of the project based on our experiences to date. This represents a strong renewal of interest in our work and they have placed some of the best staff at their disposal on the team who will be helping with this task. This team includes:

Edgardo González, Director of the Forest Bureau DNR (Dept. Natural Resources)

Pablo Cruz, USDA, Forest Supervisor of the Caribbean National Forest

Luis Rivera, Forester, USDA Tropical Vegetation Specialist, Master Arborist, Woodsman, Tree Health, Insects.

Roger W. Williams, (From USA) Director, USDA Forest Management Timber, Southern Region, (Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, Puerto Rico, South Carolina, Tennessee, Texas, Virgin Islands, and Virginia.)

Enrique Santiago, Forestry, DNR

Orlando Carrasquillo, USDA Supervisory Biological Technician, (Birds, Coquis, Frogs, shrimps, plants)

Pedro Rios, USDA Natural Resource Specialist, (Hydrologist, Agronomist, Ecosystem advisor for roads in El Yunque, Soils, Watershed)

Hecsor A. Serrano Delgado, DNR Management official, Carite Forest

### **Volunteer Tasks and Accomplishments**

- a) How did the volunteers contribute ideas, skills, expertise and motivations beyond that which you anticipated?

The volunteers put in 100% effort in carrying out the research tasks, often continuing in very wet weather, and for extra long sessions in order to complete tasks. Often it was also necessary to help out in some very mundane but very necessary areas such as drainage clearing in order to keep our main trail manageable, especially for night hiking. Once the main tasks had been grasped the volunteers often found for themselves the most efficient ways of carrying them out for any given area, and were great at organising themselves in small groups.

We had many interesting evening presentations given by volunteers, especially memorable were some of the presentations by volunteers from Eastern Europe who told us about their homelands, countries about which we previously knew very little.

- b) How have volunteers helped you to achieve your research or educational objectives? Please give specific and quantitative measures of the volunteers' contribution to your data collection.

The volunteers have helped us to carry out a full survey of our tree plantings to date and this data will be invaluable in helping us to plan the next stage of our project as we start to harvest and replant. They have also helped the staff of project Coqui to continue their mission to monitor the frog species of Puerto Rico and further understand the reasons from amphibian decline over the planet. This year they took data from 900 trees and recorded 1,800 frog sightings.

### **Educational Opportunities**

- a) Does your project directly or indirectly involve the following groups in your research topic?
- Local communities

On the level of our local community in Puerto Rico the teams of Earthwatch volunteers that come through every year have certainly raised local interest in what we are doing and our neighbours have frequently been invited up to meet and integrate with the volunteers. Our numbers of visitors has increased in 2006, these have included local artisans, farmers, forestry workers and other members of our local community who run an environmental action groups aimed at protecting areas of concern in Patillas. We have started to carry out day visit programs and overnight camps for a local Boy Scout troop. In April 2007 we will be making a radio presentation about the project on Radio Isla. In the summer months we host volunteer groups who carry out community projects locally.

- Students

Students from the University of Puerto Rico come up regularly to carry out frog studies with Pamela Medina.

- Early career scientists

Early career scientists have taken part as field team leaders and have helped with tree identification.

- Other groups

- b) Please tell us the ways your research helps these groups better understand the conservation of a sustainable environment.

Demonstrating sustainable use of tropical forestland is the overall goal of our project. We are experimenting to find practical solutions to the problem of reconciling peoples need to recover material resources from the terrain with the need to preserve the ecology of the area to prevent top soil loss, species loss, erosion, silting of rivers and lakes and degradation of the biome. Every one who visits and participates in the project can get direct hands-on experience of the benefits of sustainable forest management.

- c) Has your project helped lead to the completion of Masters' theses, or other educational research findings?

Pamela Medina will be using the data collected here to complete her Masters thesis.

### **Partnerships**

- a) List partnerships or collaborations with other organizations that you have developed or maintained in the past season.

Department of Natural Resources.  
Project Coqui  
University of Puerto Rico

- b) How have these organizations contributed to your project objectives?

Project Coqui and university of Puerto Rico students are carrying out the frog studies at the site.

Department of Natural Resources Staff are collaborating with us to develop and new project management plan.

- c) How do you anticipate these organizations will use the results generated by the project, and in what timeframes?

DNR, will be using the data to generate our overall management plan within the next year.

UPR will be using the data as part of their overall research into the islands coqui populations and the study of Chytrids fungus and its relation to the decline in amphibian populations.

### **Some Aspects of the Biology of Three Puerto Rican Declining Amphibians: *Eleutherodactylus locustus*, *E. richmondi*, and *E. wightmanae*.**

#### **SPECIFIC AIMS**

This project attempts to study several aspects of the biology of three species of declining amphibians in Puerto Rico: *Eleutherodactylus locustus*, *E. richmondi*, and *E. wightmanae*. Details on the natural history, reproductive habits, population demographic features, and distribution of these three species are relatively unknown. We would focus our research in studying these aspects of their biology in order to: (1) learn more about their biology (reproductive biology, behavior, activity, perch selection, calling sites, phylopatry); (2) establish population densities; (3) try to know if any these factors of their biology are directly contributing to their population declines; (4) establish sex rates, age structure of the population; (5) collect tissue samples in order to know which percent of the population is infected with a chytrid fungus that is affecting amphibians around the world (*Bd*); (6) find out the extent of the disappearances; (7) compare densities in the area with densities in other parts of the Island; (8) prepare a map of past/present distribution of the species around the Island; (9) produce a possible future scenario for the species with the help of a niche modeling program (GARP); (10) try to avoid their potential extinction by establishing a conservation plan for them and informing pertinent agencies in order to protect the species and their habitats.

#### **INTRODUCTION**

According to Blaustein et al. (2005), as part of an overall biodiversity crisis many amphibian populations around the world are declining. Most studies suggest that multiple causes or interactions among factors are resulting in the decline of many amphibian populations (Young et al. 2004). These include: habitat destruction, climate change, increasing levels of ultraviolet radiation, environmental contamination, and the introduction of exotic species and diseases or synergies between these factors (Blaustein et al. 2005). In recent years, herpetologists working on six continents (Africa, Australia, Europe, and North, Central, and South America) have linked amphibian declines among certain montane species to the presence of a chytridiomycete fungus in the skin called *Batrachochytrium dendrobatidis* or *Bd* (Burrowes et al. 2004).

With constant reports of amphibian declines and the recent discovery of *Bd*, it was necessary for scientists to find out all the information possible about the status, threats, and distributions of global amphibian populations. In 2004, the IUCN organized what is now known as The World Conservation Union Global Amphibian Assessment, better known as The Global Amphibian Assessment (GAA). The GAA represents the first time that each of the 5,743 amphibian species known to science at that time, has been analyzed in order to assess their status and distribution (IUCN et al. 2006).

The GAA concluded that nearly one-third (32%) of the world's amphibian species are threatened, representing 1,856 species. At least 43% of all species are declining in population, indicating that the number of threatened species can be expected to rise in the future (IUCN et al. 2006). In contrast, 27.2% appear to be stable and just 0.05% are increasing (IUCN et al. 2006). Because trends information was not available for 29.1% of species, the percentage of species in decline may actually be considerably higher (IUCN et al. 2006). Among amphibians, frogs and toads (~ 5,067 sp.) very much drive the

average threat level for amphibians as a whole with 32.6% (1,653 sp.) either threatened or extinct (IUCN et al. 2006). The highest levels of threat are in the Caribbean, where more than 80% of amphibians are threatened in the Dominican Republic, Cuba, and Jamaica, and a staggering 92% in Haiti (IUCN et al. 2006).

## BACKGROUND

Population declines have occurred in at least four endemic anuran species on Puerto Rico: *Peltophryne lemur*, and three species of *Eleutherodactylus* (*E. karlschmidti*, *E. jasperii*, and *E. eneidae*) (Burrowes et al. 2004). The latter three species have not been observed in Puerto Rico since 1976, 1981, and 1990, respectively (Burrowes and Joglar, 1991; Joglar, 1998; Joglar and Burrowes, 1996; Burrowes et al. 2004, Burrowes and Joglar, 2005). After repeated and extensive search these three *Eleutherodactylus* species have been declared critically endangered and are probably extinct (Burrowes et al. 2004; Joglar, 1998).

According to Burrowes et al. (2004), eight populations of another six species of *Eleutherodactylus* are declining significantly at high elevations (> 400 m). We are especially concerned with three of these six declining species: *E. richmondi*, *E. locustus*, and *E. wightmanae*. Recent studies have showed that some populations of these endemic species have disappeared from places where they were relatively abundant in the past. Burrowes et al. (2004) documented that populations of *E. richmondi* and *E. wightmanae* that were abundant in the late 1970's through 1982 at the UPR Biological Station at El Yunque (661m) disappeared from this site in 1987 and 1991, respectively. Also, these two species and *E. locustus* have not been seen at the Elfin forest of El Yunque since 1991 (Burrowes et al. 2004).

In general, the three species have some common denominators: limited distribution, small and fragmented populations, high degree of specialization, and are restricted to high elevations (Joglar, 1998). *Eleutherodactylus richmondi* (40-1158 m) is limited to the interior part of the Island, is specialized in humid forest and on forest ground. *Eleutherodactylus locustus* (> 370m / > 700m) can only be found in Carite Forest and El Yunque, and is specialized in humid / dwarf forests, being limited to edges of thick forest. *Eleutherodactylus wightmanae* (150-1189m) can be found in interior part of the Island (from Maricao to El Yunque) and is mostly found on the ground. These are factors that can contribute, among others, to declining amphibian populations, and are thought to be among the possible causes of extinction of the three Puerto Rican species (*E. karlschmidti*, *E. jasperii*, and *E. eneidae*) (Joglar, 1998).

The biology of the three species is relatively unknown to scientists and there really is no long-term study that will help us answer some of the conservation questions we will like to respond to. It is important to know the species you want to conserve and protect, and that is one of the aims of this study. We would focus our research in studying details on the natural history, reproductive habits, population demographic features, and distribution /status of *E. locustus*, *E. richmondi*, and *E. wightmanae* and which and how some of these aspects of their biology could be affecting their populations and status.

During this year (2007) our team will continue to work at Las Casas de la Selva once a month, to monitor populations of *Eleutherodactylus wightmanae*, a declining species of frog, endemic to Puerto Rico.

## METHODS

After preliminary studies we have selected three study sites: (1) Carite (Rte. 7740), (2) Charco Azul, and (3) Patillas (Las Casas de la Selva). Two 150 m<sup>2</sup> quadrants

have been established to study *E. richmondi*; two quadrants of 60 m<sup>2</sup> have been established to study *E. locustus*, and a 300 m<sup>2</sup> transect have been established to study *E. wightmanae*. Additional quadrants and transects will be established in other areas in order to have replicas for comparison and statistical purposes. All field research will be conducted during a period of two years.

At the beginning of each monitoring activity the following data is taken: date, time, temperature, relative humidity, wind speed, general climate conditions at the moment, and activity level of the present species. Weather stations (HOBOS) that measure temperature and relative humidity have been established at each study site with the purpose of monitoring these conditions at all times, during our study period. This information can help us to understand different activity patterns and microclimate.

All individuals within transects and quadrants on study sites will be captured by hand and each individual will be placed in a plastic bag. Each bag will be marked with a number that will match with a number on a flagging tape. The flagging tape will be placed at the same place where the specimen was found. This is extremely helpful because at the end of the monitoring activity, individuals will be returned to the same place where they were found (where the matching flagging tape was placed). Individuals will be identified by species, sex, and age. Microhabitat information, behavior, and height from the ground where they were found will be recorded and analyzed. Individuals would be measured (SVL) and described (dorsal patterns and general coloration). Each individual will be toe clipped in order to mark them and take tissue samples. Tissue will be preserved in ethylic alcohol 70% and will be examined using PCR (Polymerase Chain Reaction) to determine the presence of chytridiomycosis.

Reproductive biology will be studied in the field and in the laboratory by means of a captive breeding program at the University of Puerto Rico, Río Piedras Campus. Twenty individuals (10 males and 10 females) of each species will be placed in 10 gallons terrariums in order to observe and monitor them. Individuals will be fed with crickets three times a week and will be kept at ideal temperature (21-23°C) and humidity (>85%). Light will be controlled by a timer to maintain a 12:12 hour cycle. After the completion of this program all individuals will be returned to their original microhabitat. If any of the individuals die during this study it will be preserved and donated to the amphibian collection of the Zoology Museum of the University of Puerto Rico, Río Piedras.

In order to study species past distribution, data will be examined from museums and collections to create a past distribution map. Each of these locations will be visited to confirm species presence or absence by auditory/visual censuses and with voice activated recorders (Frogloggers) will be placed for two weeks at each locality. GPS coordinates will be recorded and then a GIS map will be produced. These localities will be visited during the wet season of the second year of the study (May-Nov 2007). These will help us establish a present distribution map that will help us know if the populations of the three species are really disappearing from places where they were relatively abundant in the past. Surveys will be performed in order to compare densities between different regions of Puerto Rico where the particular species is present.

A niche model will be generated with the Genetic Algorithm of Rule-Set Prediction (GARP) ([http://biodi.sdsc.edu/bsw\\_home.html](http://biodi.sdsc.edu/bsw_home.html)) using locality data and environmental data from digital maps, (e.g. annual temperature, annual precipitation, and altitude), integrated in a GIS environment (Ron, 2005), will be used to establish potential distributions and, by simulating potential changes in environmental data, possible future distributions. WorldClim (Hijmans et al. 2004) will be used to provide digital environmental layers that will be relevant to the biology of each of the species, including: (1) altitude, (2) mean annual temperature, (3) temperature seasonality, (4)

minimum temperature of the coldest month, (5) maximum temperature of the warmest month, (7) temperature annual range, (8) annual precipitation (Ron, 2005).

Genetic algorithms develop rules to build niche models by a process analogous to natural selection (Ron, 2005). First, the performances of set of rules are evaluated (Ron, 2005). Only the rules with the highest performance are maintained for the next generation (Ron, 2005). Then processes analogous to genetic mutation, recombination, and crossing over modify the rules randomly (Ron, 2005). Finally, the modified rules are selected before the next generation based on their performance (Ron, 2005). The process is iterated until additional generations do not improve the performance of the set of rules (Ron, 2005). GARP modeling will be carried out on DesktopGARP v.1.1.4. The output is a binary digital map with regions of presence or absence of the species in the future (Ron, 2005).

It is extremely important to monitor species status in order to help protect the species and try to establish a conservation plan for them. If, as the result of this study, any of the species is considered endangered, pertinent agencies will be informed to protect the species and its habitat.

### Las Casas de la Selva:

During 2006, our research team has been working at Las Casas de la Selva at least once a month. In addition to our monthly visits, during winter and summer we had the opportunity to work with international Earthwatch volunteers. A digital presentation introduces them to the fascinating world of amphibians and particularly of the Puerto Rican herpetofauna. Volunteers are fascinated with our amphibians, curious since their arrival, of the loud and magical noises that may have kept some from sleeping. When they find out what the frog looks like, how many species are around them, how much Puerto Ricans appreciate them, they cannot help but be curious and desperate to know more about these little “guys”. Volunteers have been extremely helpful in collecting vital data for us in the field and in helping us to answer and approach some of our aims.

On evening arrival in the field, they learn how to identify the species visually and by their calling sound. We divide the team into two groups (0-50m and 51-100m) so they can all work along the whole transect. We provide them with plastic bags with a flagging tape inside each marked with the same number. They collect the individual and put it inside the bag. The flagging tape is left at the same place where the individual was found and they write down the species, behavior, sex, microhabitat, and meter where it was found. They also record all the individuals of different species of *Eleutherodactylus* they see but cannot collect along the transect and record their species, behavior, sex, and microhabitat where found. After the volunteers finish monitoring the transect, we then collect tissue samples (toe clipping) from each individual of *E. wightmanae* collected there. These samples are taken away to be examined using PCR (Polymerase Chain Reaction) to determine the presence of chytridiomycosis.

- May 29, 2006
  - Time: 8:30 pm
  - Temperature: 23.3°C
  - Relative humidity: 77.8%
  - Wind: average 0.0 km/h and maximum 1.2 km/h

Meter	Adults <i>E. wightmanae</i>	Juveniles <i>E. wightmanae</i>	Total <i>E. wightmanae</i>
0-10	17	9	26
11-20	14	3	17
21-30	20	7	27

31-40	5	8	13
41-50	22	17	39
51-60	7	5	12
61-70	7	3	10
71-80	22	7	29
81-90	9	1	10
91-100	3	5	8
Tissue			<b>40</b>
Total			<b>231</b>

- June 12, 2006
  - Time: 8:07 pm
  - Temperature: 25.7°C
  - Relative humidity: 76.2%
  - Wind: average 0.9 km/h and maximum 1.7 km/h

Meter	Adults <i>E. wightmanae</i>	Juveniles <i>E. wightmanae</i>	Total <i>E. wightmanae</i>
0-10	7	3	10
11-20	4	3	7
21-30	3	3	6
31-40	2	3	5
41-50	3	2	5
51-60	5	1	6
61-70	10	5	15
71-80	8	1	9
81-90	7	0	7
91-100	0	0	0
Total			<b>70</b>

- December 18, 2006
  - Time: 8:24 pm
  - Temperature: 24.6°C
  - Relative humidity: 77.3%
  - Wind: average 0.0 km/h and maximum 1.5 km/h

Meter	Adults <i>E. wightmanae</i>	Juveniles <i>E. wightmanae</i>	Total <i>E. wightmanae</i>
0-10	15	17	32
11-20	11	8	19
21-30	17	18	35
31-40	11	5	16
41-50	5	10	15
51-60	13	2	15
61-70	27	13	40
71-80	3	1	4
81-90	13	1	14
91-100	15	5	20
Tissue			<b>49</b>
Total			<b>259</b>

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