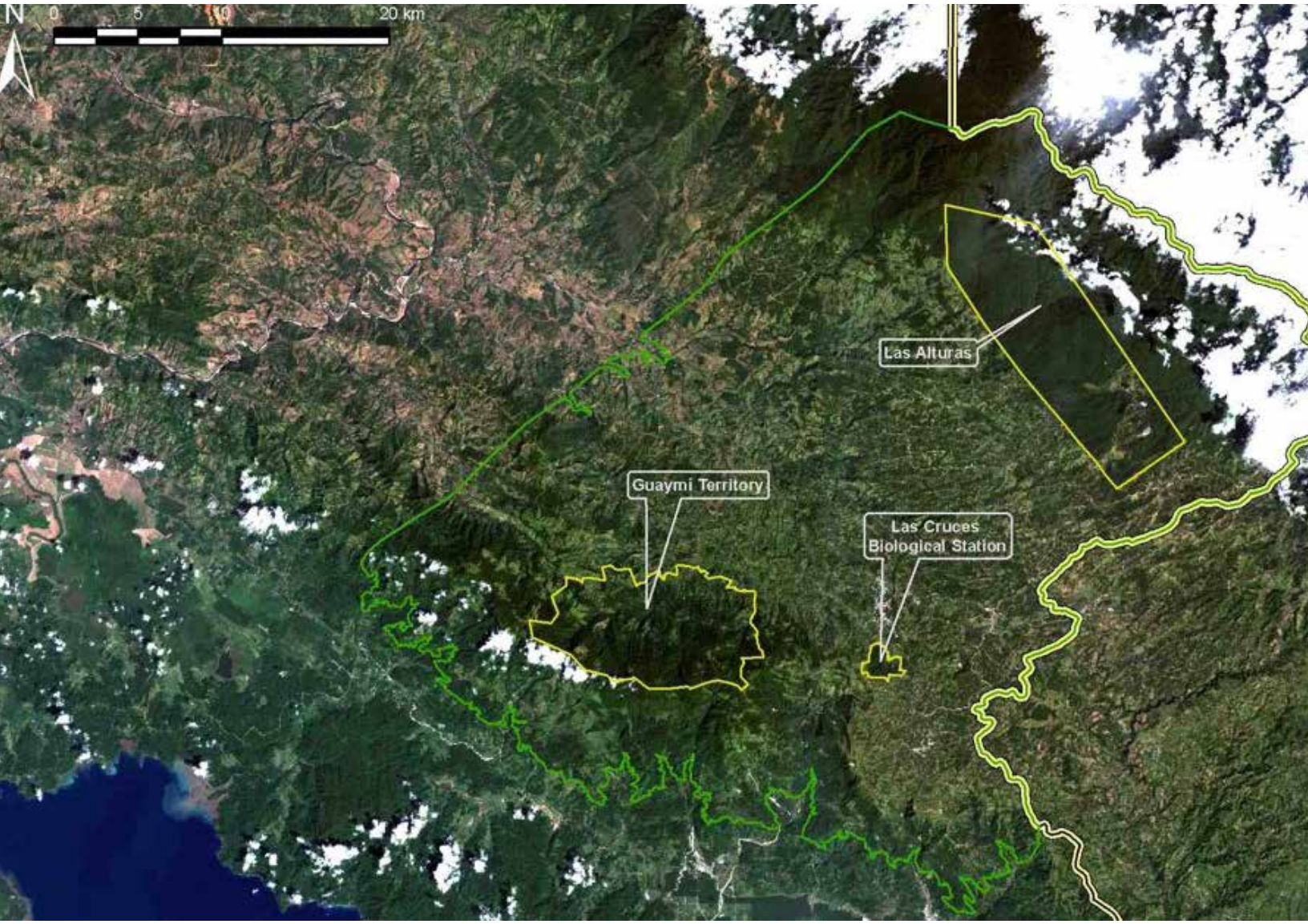
Amigos Newsletter

No. 91, May 2019



Organization for Tropical Studies

Wilson Botanical Garden
Las Cruces Research Station
Apdo. 73-8257 San Vito, Coto Brus, COSTA RICA

Who We Are

The Las Cruces Biological Station is one of three field stations owned and operated by the Organization for Tropical Studies (OTS) in Costa Rica. The station was acquired in 1973 and, along with the Wilson Botanical Garden, offers natural history visitors and researchers alike an extraordinary place to visit and conduct research.

Far from the noise and bustle of the country's capital city San José, Las Cruces is located in the remote southeastern corner of the country between Corcovado National Park on the Osa Peninsula, and the enormous La Amistad International Biosphere Reserve (472,000 hectares) that spans south-central Costa Rica and western Panama. In 1983, UNESCO declared Las Cruces and the Wilson Botanical Garden part of the Biosphere Reserve due to its incredible diversity and proximity to La Amistad.

The Wilson Botanical Garden, founded in 1962 by Catherine and Robert Wilson, is arguably the most important botanical garden in Central America and a "must see" stop on the itineraries of plant lovers, birders, and other natural history groups. It is famous for its worldwide collection of tropical plants that include palms, aroids, bromeliads, gingers, marantas, heliconias, and ferns. More than 3,000 exotic species of plants can be found in the 10-hectare (~ 25-acre) garden, including one of the largest collections of palms in the world.

There is an incredible diversity of animals that inhabit the Las Cruces reserve, and the forest fragments in the immediate surrounding area. The bird list has registered 410 species; close to half the number of birds found in all of Costa Rica. There are also more than 100 species of mammals, of which 60 are bats. Some of the more commonly sighted mammals include agoutis, white-faced capuchin monkeys, kinkajous, olingos, and tayras. Reptiles and amphibians also thrive in this moist, cloud-laden habitat and there is an impressive diversity of insects, and in particular moths and butterflies.

Las Cruces protects more than 200 hectares of primary forest (home to some 2,000 native plant species) and ~150 additional hectares that are in various stages of forest recovery. The reserve is surrounded by a mosaic of mixed-use agricultural fields and forest patches, and it is this fragmented setting that makes Las Cruces an ideal place to study the effects of forest fragmentation and isolation on animal and plant communities. The landscape surrounding Las Cruces is also ideally suited for research on biological corridors and restoration ecology; key fields of research that are of ever increasing importance. Part of our mission at Las Cruces is to continue to purchase land for reforestation and, in doing so, expand our protected areas and connect some of the isolated forest fragments around the station. For further information on this campaign please visit the Las Cruces website.

At approximately 1,200 meters elevation (3,900 feet), the prevailing temperatures at Las Cruces are cooler than one might expect. Temperatures range from 21-26 °C (70-80 °F) during the day and 15-21 °C (low 60's) at night. Mean annual rainfall is ~4,000 mm (157 inches)! The dry season runs from January – March, and the rainy season from May – November. Most visitors and researchers come during the dry season.

The station is well known for its visitor-friendly amenities: comfortable private sleeping quarters, excellent meals, knowledgeable and enthusiastic staff, and a well-maintained network of paths and trails. The nearest town is San Vito, the municipal capital of Coto Brus county. It was founded by Italian immigrants in the 1950's and to this day they have a strong presence in the community. For example, a Dante Alighieri Italian-Costa Rican Community Center provides Italian language instruction and Coto Brus is the only county in Costa Rica where Italian forms part of the elementary curriculum! But enough said here! We hope that you will be inspired to come and experience firsthand the splendid tropical diversity of the Las Cruces Biological Station and Wilson Botanical Garden!

Please visit the Las Cruces website at http://www.tropicalstudies.org/lascruces for more information or contact us directly by email at lcruces@tropicalstudies.org or telephone at: +506 2773-4004. Postal mail can be sent to: Estación Biológica Las Cruces/Jardín Botánico Wilson; Apdo. 73-8257; San Vito de Coto Brus, Puntarenas; Costa Rica.

Reservations can also be made by contacting the OTS office in San José by email: threepaths.reservaciones@tropicalstudies.org or by telephone +506 2524-0607.

The North American OTS office is located at Duke University, telephone: +1 (919) 684-5774 or email: ots@tropicalstudies.org

The Organization for Tropical Studies is a nonprofit consortium of universities and research institutions in the U.S., Costa Rica, Peru, Mexico, South Africa, and Australia.

Founded in 1963, OTS is dedicated to providing leadership in education, research and the responsible use of natural resources in the tropics. To this end, OTS offers graduate, undergraduate and professional education, facilitates research, participates in conservation activities, conducts environmental education programs and maintains three fields stations in Costa Rica: La Selva Biological Station in the Atlantic lowland rain forest; Palo Verde Biological Station in the Pacific deciduous dry forest; and Las Cruces Biological Station in the premontane cloud forest near the Panamanian border.

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Front Cover: Area of influence of the Luis Diego Gómez Herbarium (the line is the limit of the area).

Back Cover: Students of the Environmental Interpretation course, University of Costa Rica, at Las Cruces Research Station. Photo by Ashley Wroe."

Editorial Committee: Rodolfo Quirós F., Amanda Wendt

What's New at Las Cruces?

The "gardeners", L-R: José Mendoza, Miguel Rojas, Jesús Marchena, Uriel Atencio, Franklin Cortés. Photo by Alison Oliviery.

Remembering José Mendoza

We are sad to report that one of our long-time members of the staff at the station has passed away last January. Mr. José Mendoza, one of the gardening crewmembers worked at the station since 2001. He retired in 2018, after almost 17 years of service and friendship. He lost the battle against a bacterial infection that took his life within a few days in the hospital.

Mendoza, with his paused way of walking and speaking, gained respect and friendship among all who had the opportunity to meet him. At the station, he was always with a smile. If the chance allowed, he would produce one of his questions about any of nature's processes that seemed profoundly interesting for him, or show up at the office door to greet anyone who would be there with his "*May I take a minute of your time to say hello?*".

The personnel of the station invited Mendoza's family to share our support and friendship through the dedication of a bench to his memory, *for his more than 16 years providing beauty to the garden*.

Bird Signs in the Main Terrace

A set of interpretive panels has been located at the main terrace in front of the dining hall. These signs talk about the birds that are commonly seen in that place, including hummingbirds in the bottlebrush tree, the birds that come to the railing for fruit, or the migrant birds moving through the surrounding vegetation. They show a fraction of the species of birds to be seen at the terrace, and it is an invitation to explore the bird fauna for which Las Cruces is also famous.

The panels are part of the science interpretation initiative that we have been developing for over a year with the help of artist Deirdre Hyde, who, among other things, donated the design. Several friends of the station contributed the pictures of the birds depicted in the five panels. Funding for these panels comes from a generous donation from Mr. James F. Dayton, good friend of the Wilson Garden, and Mrs. Julie Gibson, long-time supporter of the station.

Fire in the Pasture

Thursday March 7th. At around 2:00pm a fire alert is received at the Reception from a neighbor who saw smoke coming out of one of the station's properties. Our Emergencies Committee dispatched personnel to look into the situation who later reported a fire in one of the restoration areas on the Northern boundary of the station. In the end, the fire consumed 3 hectares (7.5 acres) of open field.

The place is a pasture area annexed to the station in 2015 with the purpose of restoring it through natural regeneration, and available for any related research projects. The place is somewhat hilly, and most of it is covered with grasses left from the cattle operation on the farm before it was purchased. Access to the place is difficult as the road conditions do not allow for large vehicles to arrive close to the fire site. Members of the San

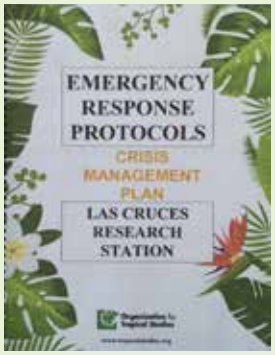
Vito Fire Department arrived to inspect the situation, but the large truck could not move up the road. Along with the personnel, friends of the station arrived to help contain the advance of the fire, which was finally controlled after 5 hours of hard work. The source of the fire has not been determined, but with the combination of dry vegetation, product of several months of drought, and strong winds, the job of stopping the fire was very difficult.

Our deepest *Thank you!* to all the people who voluntarily helped us contain this fire. Their help included fighting directly with the flames, bringing water to kill the fire or for the people to drink, or simply watch and report where the fire was moving. Without their help, this emergency might have affected the old-growth forest, a valuable remnant of the middle elevation forest that not long ago was covering the Coto Brus Valley.

Part of the pasture area affected by the fire.

New Emergency Protocols for the Station

In your next visit, you will find a booklet on the desk of your room to tell you about the procedures in case of an emergency. With three field stations and an administrative office in Costa Rica, the Organization for Tropical Studies (OTS) decided to homogenize all the emergency protocols in each one of those sites, as each one of them had their own way of telling the visitors about the different risks they may experience while at the station.



The task was to collect any written materials the stations had, plus, through interviews, collect experiences that the personnel has had when dealing with different emergencies. The product is a booklet containing emergency protocols on situations like snakebites, attacks from Africanized bees, earthquakes, fire, wind and electric storms, robbery, car accidents, flooding, volcano eruptions, and tsunamis; plus indications on how to act on medical and psychological first aid.

These protocols are clearly written and easy to follow, so that any visitor of the station –tourists, students, researchers, volunteers and interns- can help with the basics of the situation at hand, prior to the arrival of the emergency brigades of the station or specialized units to work on controlling the situation. The booklets are located in all of the cabins and the main areas with concentrations of people, like in the classrooms, reception, laboratory, library and dining room.

Ces't une Plante Exotique

Often times we meet visitors who ask, "*How can you use my time at the station?*" Excursia, a company that provides French tourists with educational activities through their visit in Costa Rica, brought one such question to us. They requested to include in the visit a hands-on experience for their customers, "*something of impact*."

Among other things, the station is dealing with the control of a few exotic species that dispersed from the botanical garden into the adjacent forest. Dealing with one of those species represents a lot of work, and we are always thankful when there are more hands and a lot of energy to remove such plants. The field activity starts with a conversation on what are exotic and invasive plants, their requirements and disadvantages of having them in the native forest, and how do they arrive and struggle to be there. After that, we go hunting for the plants. We bring pruners, machetes, shovels, plastic bags and sacs. After learning what the target plant looks like and how to remove it, it is a matter of a short period of time that a large section is released from the presence of the plant. Time goes by quickly, and everybody enjoys the activity, as it is an opportunity to learn and to contribute to maintain the native forest in good standing.

Depending on the species, we either remove the flowers before they produce fruits or remove the ripe fruits from the plant –control of Pinanga palm in the botanical garden (Photo by Yessenia Quesada)

A Tree Nursery for Restoring Land in Coto Brus

Rodrigo De Sousa Hernández / rsousa@master.upeace.org

In order to have a wide mix of native tree species available for local restoration and reforestation projects, in August 2018 we began collecting seeds and seedlings at Las Cruces Biological Station as well as in nearby forests and around remnant trees. As of March 2019, we already have more than 2,000 trees from over 25 species that we will set for planting in this year´s wet season.

In addition, we continue to plant seeds and seedlings from new species in order to create a wide mix, which can closely reflect the high biodiversity of trees that prevails in primary forests in the area. It has been an intense and ongoing learning process about identifying species and selecting the best way to propagate and nurture them.

The process from initial propagation to definitive planting in the field is divided into four "stations":

The time for a seedling to stay in stations 2 and 3 vary greatly between species, but normally it takes about 2 to 4 months for a tree to go from station 1 to station 4.

Through this project, we have learned about the management of different species of trees in the nursery. Eventually, we will learn about their performance after planting them in the field. We are deciding on the areas for reforestation with these trees; initially, we are thinking about the piece of pasture area that burned recently on one side of the station.

Thanks to the great teamwork of the garden staff, the tree nursery keeps expanding in order to meet the great need for restoring and reforesting land in the Coto Brus Region of Costa Rica.

Station 1 takes place at the shadiest and most humid part of the main nursery greenhouse, where we either sow seeds in trays or plant young seedlings in small pots (*Tabebuia ochracea*)

After about 3 to 4 weeks, we move these seedlings to a sunnier location in the main nursery (station 2) until the roots grow and occupy the whole volume of the pot (*Clusia*).

In station 3, we transplant seedlings into medium sized plastic bags and place them at the sunniest location inside the greenhouse.

Finally, we move the young trees to an outside location so they are fully adapted to heavy rain and full sunlight before being planted in the field.

Family	Species
Bignoniaceae	*Tabebuia ochracea*
Combretaceae	*Terminalia amazonia*
Fabaceae	*Calliandra calothyrsus*
Fagaceae	*Quercus insignis*
Lauraceae	*Persea caerulea*
Meliaceae	*Cedrela tonduzzi*
Myristicaceae	*Otoba novogranatensis*
Clusiacae	*Clusia* sp
Fabaceae	*Inga* sp
Fabaceae	*Senna* sp
Moraceae	*Ficus* sp
Lauraceae	Several species
Melastomataceae	Several species

El Vencejo Común (Chaetura vauxi) en Las Cruces

Jeisson Figueroa Sandí / jeisson.figueroa@tropicalstudies.org

El 21 de diciembre de 2018, estando en la torre de observación con un grupo de visitantes alrededor de las 16:45 pm, observamos un gran grupo de vencejos comunes o grisáceos volando sobre nosotros y, así como llegaron, desaparecieron. Al terminar la caminata, me di a la tarea de averiguar qué pasó con este gran grupo de vencejos. Buscándolos por donde fue la última vez que los vi pensé que se fueron a dormir entre los bambúes, pero no fue así. Busqué un poco más por las zonas aledañas hasta lograr escuchar su canto y, siguiéndolo, logré llegar hasta donde estaba su lugar para dormir: un tronco de palma muerto y hueco.

Al siguiente día llegué temprano para saber a qué hora despertaban. A las 5:00 am, estando todavía oscuro, podía escucharlos dentro del tronco hueco. No fue sino hasta alrededor de las 6:20 am que empezaron a salir. Fue increíble ver la cantidad que estaban durmiendo dentro del tronco: calculé entre unos 400 a 600 individuos.

Durante dos semanas seguí visitando este dormidero para determinar a qué hora salían para comer o entraban para dormir. En la mañana, salían entre las 6:00 am y las 7:00 am; casi siempre todo el grupo salía en un mismo momento, tardando de 3 a 7 minutos. Por la tarde variaba un poco, llegando siempre en grupos dispersos entre las 16:40 pm a 17:30 pm. Es impresionante ver la velocidad con que ingresan al tronco de palmera hueco. Algunas de ellas chocaban con el tronco, pero luego se recuperaban fácilmente y volvían a intentarlo.

Estos vencejos se alimentan en vuelo de insectos voladores. Su dieta incluye escarabajos, avispas, termitas y hormigas voladoras.

Los vencejos comunes se distribuyen desde el sur de Alaska hasta el norte de Venezuela. Las poblaciones de Norte América son migratorias, pasan el invierno norteño en los trópicos, desplazándose desde el centro de México hasta Centro América y la parte norte de Sur América.

Los vencejos comunes anidan en las montañas y las colinas, desde el sureste de Alaska y Montana hasta el centro de California, principalmente por encima de los 700 m. Construyen un nido en forma de taza con ramitas y saliva en una superficie vertical en una cavidad oscura, como un agujero de árbol, grieta de acantilado o incluso áticos. Incuban tres huevos blancos entre marzo y julio.

Dormidero de los vencejos
Swifts' roosting place
Photos by Jeisson Figueroa

Vaux Swift (Chaetura vauxi) in Las Cruces

December 21st, 2018, while in the observation tower with a group of visitors around 16:45 pm, we observed a large group of Vaux Swifts flying over us and, just as they arrived, they disappeared. At the end of the walk, I gave myself the task of finding out what happened to this large group of swifts. Looking around the place I saw them for the last time, I thought that they were sleeping among the bamboos, but they did not. I searched a little more the surrounding areas to listen to their singing and, following it, I managed to get up to where their sleeping place was in a dead and hollow palm trunk.

The next day I arrived early to see at what time they "get up". At 5:00 am, while still dark, I could hear them inside the hollow trunk. It was not until around 6:20 am that they began to leave. It was amazing to see the number of them staying inside the trunk: I figured some 400 to 600 individuals.

For two weeks, I kept visiting this roost to determine at what time they went out to eat or came back to sleep. In the morning, they came out between 6:00 and 7:00 am; usually the entire group came out at once, taking 3 to 7 minutes. In the afternoon, it varied a bit, always arriving in scattered groups between 16:40 and 17:30 pm. It is impressive to see the speed with which they entered the hollow trunk of the palm. Some of them clashed with the trunk, but then recovered easily and came back to try it.

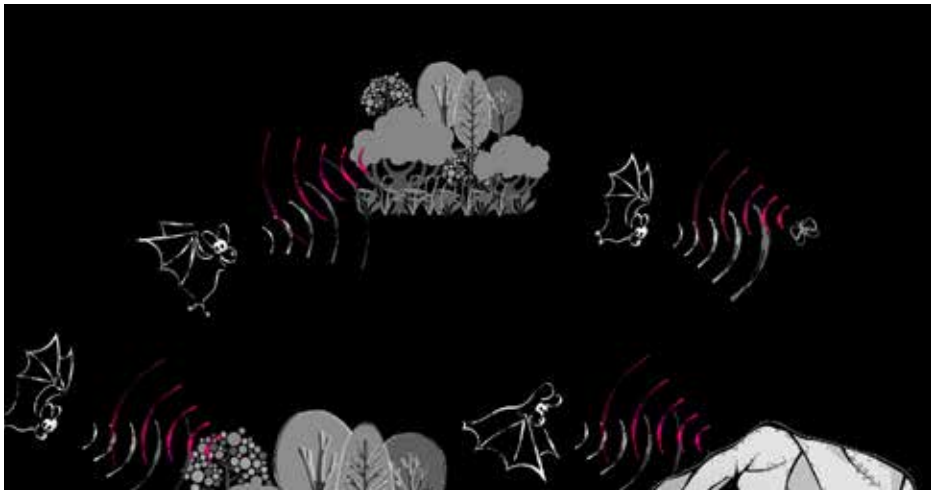
These swifts feed on flying insects while gliding in the air. Their diet includes beetles, wasps, termites and flying ants.

The distribution of the Vaux Swifts is from southern Alaska to the North of Venezuela. Populations in North America are migratory, spending the northern winter in the tropics, moving from Central Mexico to Central America and northern South America. They nest in the mountains and hills, mainly above 2300 ft. They build a cup-like nest with twigs and saliva on a vertical surface in a dark cavity, such as a tree hole, crack of cliff or even attics. They incubate three white eggs between March and July.

Research at Las Cruces

Finding Food in a Warming World: Is this a problem for insect-eating bats?

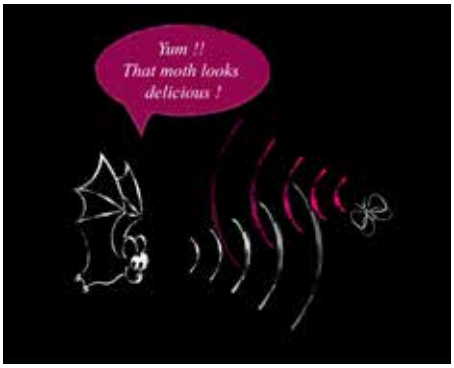
Paula Iturralde-Pólit, Universidad de Costa Rica / iturraldepolitpaula@gmail.com

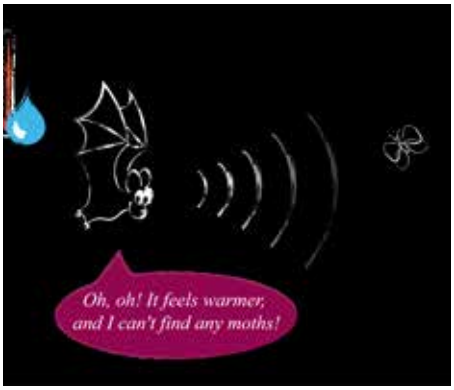


I focus my research on echolocating bats because they have an outstanding ability to use acoustic signals to create images of their surroundings, at night. Bats detect the returning echoes of the calls that they produce for orientation, to localize food, and to find roosts.

Insectivorous bats play important roles in the ecosystem as they prey on insects that are often agricultural pests; however, in order to be effective localizing, classifying, and capturing prey, they rely on their high frequency calls, also known as echolocation calls. These calls are particularly sensitive to atmospheric attenuation, the process over which sound becomes increasingly fainter with distance, and is worsened by warmer temperatures. Hence, due to climate change the attenuation of bat sounds may become stronger, altering the distance at which their calls can be recognized and decoded.

Even modest shifts in atmospheric conditions could reduce the range of detection of bats' prey, although small changes in call parameters might help bats keep it constant. The question that I am addressing is whether insectivorous bats will be able of maximizing prey detection ranges to capture enough food, independently of weather conditions. In principle, I would say YES, they can!





Figures by Lena Framond

Bats are known to have very flexible echolocation calls. This means that they regulate their vocalizations depending on where they hunt, what they eat and how they acquire food. Bats also adapt their calls according to weather conditions to successfully locate prey. An understanding of how weather conditions influence bat sonar signals might be useful for predicting their sensitivity under current trends in climate change. To address my question, I am working at Las Cruces Biological Station where I record the echolocation calls of bats with four special microphones inside a closed room at different combinations of temperature and humidity. I am testing if bats are actually capable of modifying their call parameters when temperature and humidity change in a short period of time.

By modifying the parameters according to environmental conditions, bats will be able to overcome the effect of atmospheric attenuation. They could decrease the frequency of the call, call louder, call longer, or combine two or more of these strategies to maintain their feeding efficiency.

Still, I need to determine if bats' adaptations will be effective at neutralizing the effects of increasing temperatures and relative humidity. What are their limitations? How sensitive are different species to global warming? I will keep tracking insectivorous bats, searching for answers to these questions.

Keep tuned to the results of this study to learn more about the fantastic capacities of these curious and amazing flying mammals.

What Can Bat Poop Tell Us About Past Tropical Landscapes?

Rachel Reid / rachel.beth.brown@gmail.com

Many people head to Costa Rica for spring break to see monkeys and sloths at Manuel Antonio National Park or to try their hand at surfing in the Pacific. While we did stop to gawk at the crocodiles that hang out under the bridge over the Tárcoles River with a busload of tourists, the goal of our trip diverged significantly from the spring break crowd – we were heading off the beaten path to southern Costa Rica to collect samples of modern and ancient bat guano (aka poop).

Bats sometimes visit the same caves over thousands of years, and the accumulated piles of guano offer a unique opportunity to study past environments. Just like a core of sediment from the bottom of a lake or the ocean, a core of bat guano collected from a cave contains useful information about the past, both recent and distant. The material at the bottom of the core is the oldest and that at the top is the youngest, so by sampling the length of a core, we can essentially take a short, stinky walk back in time.

We are interested in detecting changes in bat guano chemistry (particularly the carbon isotope values) through time as a way of evaluating what type of vegetation would have been on the landscape in the past. This works because information about the plants at the base of the food chain gets propagated up to the plant-eating insects and then to the insect-eating bats whose guano we are sampling.

Like other animals, bats and insects both gain carbon and nitrogen through the food they eat. Bats eat insects, which are in turn eating the local vegetation. Different types of plants have different carbon isotope values, such that most trees and shrubs (*C3 plants*) have much lower carbon isotope values than most grasses (*C4 plants*). Shifts in tropical bat guano carbon isotope values, therefore, are indicative of landscape-level changes in vegetation between more open, grassland plants and tropical forest.

How does bat poop inform conservation?

In the late 1940s, southern Costa Rica was nearly 100% forested. We know this from aerial photos – the earliest ones are from 1948. In later years, aerial photos show that most of that forest was cleared for coffee plantations; two thirds of it was cleared by 1980, for example.

This recent deforestation has motivated forest restoration efforts such as the creation of biological corridors and international scientific studies. Nonetheless, several studies suggest that

extinction rates in this region may be lower than would be predicted from recent habitat loss. One explanation for this could be that the regional flora and fauna evolved for several thousand years in a mixed forest and non-forest landscape managed by humans. By piecing together records of past vegetation from bat guano cores, we will be able to gain a better picture of what the landscape would have looked like in the

The bat guano team. From left to right: Leighton Reid & Christy Edwards (Missouri Botanical Garden), Rachel Reid & Alice Xu (Washington University in St. Louis), and Jeisson Figueroa (Organization for Tropical Studies). Photo by Jeisson Figueroa.

past and potentially refine landscape-scale conservation and restoration targets.

For this first trip, our goals were to visit several caves to collect samples and to scout out future sampling opportunities. Southwestern Costa Rica has the highest concentration of karst caves (the caves formed from the dissolution of soluble rocks, such as limestone) in the country, so we were in the right place. In four days of fieldwork, we visited three different caves (two of them twice!), collected 77 cm of core material, and took dozens of samples of modern bat poop.

At Bajo Los Indios Cave, also known as Corredores, along the Rio Corredor, we ventured into a restricted, elevated chamber in hopes of finding deeper, more protected accumulations of guano. We were disappointed to find that even in this higher chamber, the cave was very wet and muddy and any significant guano accumulations appeared to have washed away. We collected a guano/mud core anyway and we will see what we can learn from it.

One additional important piece to our project is to try to get a better idea of what modern insectivorous bats, such as the mesoamerican mustached bat (*Pteronotus parnellii mesoamericanas*, pictured at the top of this article), are eating. We will then use that information to better interpret our results back in time. We are excited to start analyzing samples!

This pilot study was generously funded by grants from the Living Earth Collaborative and from the International Center for Energy, Environment and Sustainability.

Rachel Reid is a postdoctoral researcher at Washington University in St. Louis. She uses isotope chemistry to answer questions about ecology, geology, and conservation – including questions that can help build reference models for ecological restoration.

Flora and Fauna

Ten Years of the Luis Diego Gómez Herbarium

Rodolfo Quirós F., Las Cruces' Academic and Research Logistics Assistant / rodolfo.quiros@tropicalstudies.org

The Luis Diego Gomez Herbarium (HLDG) was created in 2008, as a response to the need for researchers who visit Las Cruces Biological Station of having a site where the flora of the Coto Brus Valley is represented. The Herbarium aims to generate knowledge about plant biodiversity of the area of influence of the station, which can be used by students, researchers and decision makers for conservation purposes. It was indexed at a global level in 2008, and its collection contains botanical samples since 1998.

The sampling area covers about 1400 km2 (540.5 square miles). The change in elevation ranges from 300 to 3300 meters (985 to 10825 ft) above sea level. It covers the Coto Brus Valley, which includes the entire Coto Brus county and sectors of the Corredores, Buenos Aires and Golfito counties. The collecting places include the rainforest along the Fila de Cal, dry forest at Paso Real and areas of cloud forest at the Cerro Paraguas and on the slopes of the Cordillera de Talamanca, and all their transitions on the inside of the valley (see figure on the cover). Depending on the area, the average annual precipitation varies from 2000 to 6000 mm (122 to 365 in3), which influences the environments from dry to rain and cloud forest.

The region includes protected areas, such as La Amistad International Park and the Las Tablas Protective Area, the Gnöbe of Coto Brus indigenous territory, and properties with different management and uses. This area is a mosaic of forest fragments of different sizes and ages, in some cases connected to each other by a series of mini-corridors, but for the most part isolated and threatened with being even more reduced. There are several lakes and wetlands of importance due to their interesting plant diversity, with species of restricted distribution, and some very uncommon plants. Deforestation and other vegetation changes are still occurring.

In ten years of growth, the HLDG collection contains 5139 specimens gathered from the Valley of Coto Brus, representing 2260 species of vascular plants belonging to 901 genera and 187 families (see table). Most are dicotyledonous plants. The collecting locations include different environments, such as forests, forest fragments with different size, age and history, roadsides and riverbanks, creeks and lakes, agricultural and forest plantations, or cattle land.

The HLDG collection contains 5139 records of specimens collected in the field that have been scanned and associated with the records in the database. In addition, we have other collections at the herbarium, including wet collections of flowers, fruits and seeds. There is also a collection of dry parts of leaves that can be used for DNA studies.

Whenever we collect in the field, we take photographs of the habit of the plant and some distinctive and relevant features of the flowers, fruits, sporangia, or other structures present and with taxonomic value. The pictures are included in the database as supporting information resources. The photographic collection adds up to 16000 images. There is also a collection of pictures of seeds.

The herbarium database has a digital platform on the internet where all the information of the specimens can be accessed, with images of the collections and relevant pictures, which guarantees access to the information generated.

All this collecting effort has yielded a better understanding of the native flora of this sub-region that has traditionally been poorly studied. As outstanding products, a species new to science has been

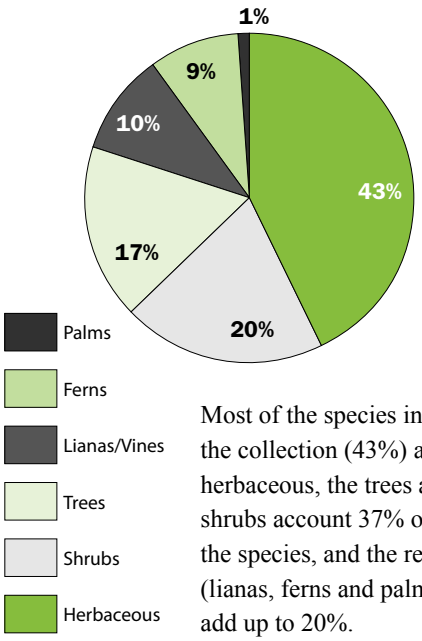
described: *Miconia povedae*, as well as two natural hybrids of ferns: *Serpocaulon* × *sessilipinnum*, and *Serpocaulon* × *rojasianum*. We have also collected a fern species that had very few records in the National Herbarium *(Pteris longifolia*, Pteridaceae), as a new record found in the Fila de Cal, as well as specimens that will expand the range of several species considered of lower altitudinal distribution.

Number of families, genera and species of plants from the Coto Brus Valley contained in the collection of the Luis Diego Gómez Herbarium (HLDG).

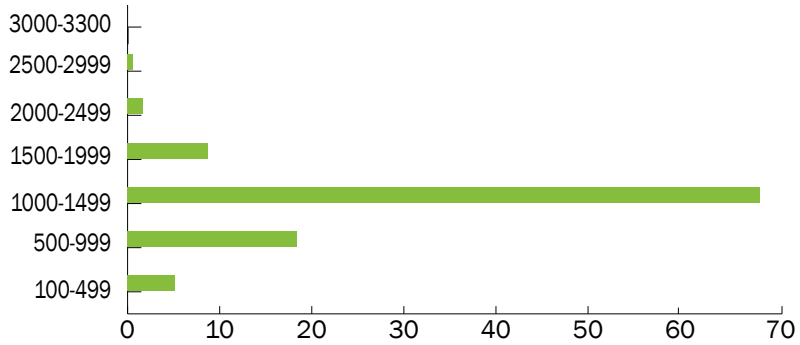
Class	Orders (#, %)		Families (#, %)		Genera (#, %)		Species (#, %)	
Equisetopsida	16	26.23	30	16.04	75	8.32	218	9.65
Lilliopsida	10	16.39	27	14.44	215	23.86	619	27.39
Magnoliopsida	35	57.38	130	69.52	611	67.81	1423	62.96
Total	**61**		**187**		**901**		**2260**	

	Families	No. of Species		Families	No. of Genera
1	Orchidaceae	204	1	Orchidaceae	79
2	Fabaceae	126	2	Asteraceae	66
3	Rubiaceae	109	3	Fabaceae	53
4	Melastomataceae	104	4	Poaceae	46
5	Asteraceae	97	5	Rubiaceae	37
6	Poaceae	90	6	Malvaceae	27
7	Piperaceae	77	7	Melastomataceae	25
8	Araceae	68	8	Apocynaceae	17
9	Heliconiaceae	56	9	Polypodiaceae	16
10	Solanaceae	52	10	Acanthaceae	14
11	Cyperaceae	47	11	Euphorbiaceae	14
12	Polypodiaceae	46	12	Cucurbitaceae	12
13	Malvaceae	44	13	Solanaceae	12
14	Lauraceae	43	14	Araceae	11
15	Bromeliaceae	38	15	Bromeliaceae	11
16	Euphorbiaceae	37	16	Lamiaceae	11
17	Gesneriaceae	36	17	Arecaceae	9
18	Dryopteridaceae	33	18	Bignoniaceae	9
19	Lamiaceae	28	19	Cyperaceae	9
20	Moraceae	28	20	Pteridaceae	9
	60.31%	**1363**		54.05%	**487**
Other	39.69%	**897**	Other	45.95%	**414**
		2260			**901**

The orchid family is the most represented with 204 species in 79 genera. The twenty families with more plants, or with the largest number of species, contain 60.31% of all identified species, and 54.05% of all genera.



Most of the species in the collection (43%) are herbaceous, the trees and shrubs account 37% of the species, and the rest (lianas, ferns and palms) add up to 20%.



The majority of the samples (84.55%) have been collected from 500 to 1500 m. (1640 to 4920 ft) a.s.l.

Interpretación Ambiental: Percibir, observar y escuchar de forma distinta para reflexionar, motivar y cambiarse a sí mismo

José Ureña Monge, Environmental Interpretation, Universidad de Costa Rica / jose.urena.monge@gmail.com

La Interpretación Ambiental es una disciplina en que el proceso de comunicación forja conexiones intelectuales y emocionales para que las personas descubran el significado de las cosas, lugares y eventos, por medio de experiencias y con instrumentos ilustrativos en lugar de solamente brindar información. Con esto en mente, los estudiantes de la Licenciatura en Interpretación Ambiental de la Universidad de Costa Rica realizamos una visita de trabajo a la Estación Biológica Las Cruces y el Jardín Botánico Wilson. Una charla introductoria nos invitó a pensar más allá de los fenómenos presentes y observables del lugar. Al día siguiente fuimos descubriendo estos fenómenos durante un recorrido guiado que fue adaptado a lo que buscábamos, lleno de anécdotas, con datos curiosos y descripciones tangibles e intangibles de lo que íbamos encontrando, usando siempre los cinco sentidos porque sabíamos que todos percibimos, aprendemos e interpretamos de manera distinta.

Como productos de esta visita, generamos múltiples materiales interpretativos no personales (autoguiados) para variedad de audiencias. Entre ellos, recorridos por algunos senderos que describen diversos temas y recursos, como "El Jardín Wilson: una aventura evolutiva", "Sendero Jurásico", "Relaciones planta-animal: ¡lo que se ve no es todo lo que hay!", "Polinización por abejas guiada por sentidos", "Madera y carbono" y "Explorando los pequeños secretos de gigantes antiguos". También elaboramos juegos de memoria, como "Organismos xilófagos", "La problemática de los pesticidas", uno sobre detectives llamado "Los Expedientes Secretos de

la Briosfera", y un cuento, "El Relato de las abejas". Todos ellos buscando revelar al visitante significados nuevos sobre la historia, relaciones y conocimiento de la naturaleza por medio de la experiencia.

Después de dos días de exploración, nos convencimos de que este sitio tiene un potencial inimaginable como escenario de investigación, y para llevar a cabo proyectos interpretativos, de educación ambiental, comunicación de la ciencia, gestión ambiental y de otras muchas disciplinas. La experiencia es especialmente enriquecedora por ser un lugar dedicado a la conservación y el estudio de la diversidad circundante. Así, nos involucramos en una visita al Herbario Luis Diego Gómez, descubrimos estudios etnobotánicos, y fuimos parte de los esfuerzos de sostenibilidad ambiental de la estación, entre otras cosas que experimentamos. La interacción con el personal de la estación fue inspiradora: estamos agradecidos con el personal de la cocina por compartir sus deliciosas recetas con nosotros, y con el resto del personal por mostrarnos el lugar desde un enfoque distinto y aclarar nuestras dudas, y por hacer nuestra estadía muy agradable y nuestro trabajo más divertido y ameno.

Environmental Interpretation: Perceive, observe and listen in a different way to reflect, motivate and change oneself

Environmental interpretation is a discipline in which the communication process forges intellectual and emotional connections by which people will discover the meaning of things, places, and events, through experiences and illustrative instruments instead of only providing information. With this in mind, the students of Environmental Interpretation of the University of Costa Rica made a field trip to the Las Cruces Biological Station and the Wilson Botanical Garden. After two days of exploration, we were convinced that this site has an unimaginable potential as a setting for research, as well as a place to carry out interpretive projects on environmental education, science communication, environmental management and other disciplines.

As products of this visit, we generated multiple non-personal interpretive materials (self-guided) for a variety of audiences. Including tours of some trails that describe various topics and resources, such as "The Wilson Garden: an evolutionary adventure ","Jurassic trail", "Plant-animal relationships: what you see is not all there is!", "Bee pollination guided by the senses", "Timber and carbon" and "Exploring the small secrets of ancient giants". We also made memory games, such as "Xylophagous organisms", "The problem of pesticides", one about detectives called "The Bryosphere Secret Files", and a short story, "The bees' story". All of them designed to reveal to the visitors new meanings on history, relationships and knowledge of nature through the experience.

Quetzals: a Las Cruces Perspective

Alan F. Poole / afp7@cornell.edu

A first-time visitor to Las Cruces cannot help but be dazzled by the birds that are found there. The array of brilliantly-plumaged tanagers at the dining hall fruit feeders each morning; the flocks of chattering parakeets racing by overhead; perhaps a darting coquette hummingbird at a flowering shrub in the pollinator garden; or the soft hooting call of the Blue-crowned Motmot at dawn. All these and more are woven into the indelible experience that a visit to Las Cruces provides.

But almost invariably birders arriving at Las Cruces ask about one species in particular: the Resplendent Quetzal (*Pharomachrus mocinno*). This stunningly beautiful bird, a member of the trogon family (Trogonidae), is found at elevations higher than Las Cruces, in cloud forests from southern Mexico to central Panama. A key part of its range includes the western edge of the Talamanaca Mountains just an hour's drive from Las Cruces. Therefore, while the station may lack quetzals in its forests and gardens, it provides a convenient base for anyone interested in these elusive birds. In fact, I was introduced to the glory of Resplendent Quetzals soon after my initial arrival at Las Cruces in January 2017.

A male Resplendent Quetzal at Las Tablas. Photo by Jeisson Figueroa."

My introduction was courtesy of San Vito's Desafios Tours, with the very capable Henry Barrantes as my guide. Our destination was Las Tablas, a privately owned area on the edge of Las Amistad National Park, close to the Panama border. Winding up a narrow, challenging dirt road, fording streams and entering magnificent primary forest, sonorous with the calls of bellbirds (*Procnias tricarunculatus*), we arrived at an aging ranch house surrounded by cattle pasture. Forest was a short walk away and from the forest edge came the distinctive flight calls of the Resplendent Quetzal, a rolling chatter "kwah, ka, ka, ka.... waka, waka waka."

It is hard to describe this quetzal without tripping over superlatives. Loose, shimmering plumage of brilliant greens, pale blues, and deep reds; three-foot long tail plumes trailing behind courting males in flight; individuals swooping in to feed on fruits high in the canopies of cloud forest trees. Only a handful of birds on our planet possess such charisma. This quetzal takes your breath away, and not just the first time you see it.

Resplendent Quetzals have awed humans for millennia. They were a central feature of Aztec and Mayan religions, depicted in painting and sculpture at least 2,000 - 3,000 years ago, their feathers woven into sacred headdresses for priests and royalty. Demand for these feathers spurred far-reaching trade, from highland forests in present-day Honduras and Guatemala to ancient cities along the coast of Belize, up into the Central Valley of Mexico.

Up to about 50 years ago, populations of Resplendent Quetzals appeared fairly robust. Today, numbers are plummeting. Mexico has lost nearly 80% of its quetzals in the past 30 to 40 years, as forest habitats have been decimated by logging and farming; just a few hundred pairs remain in dwindling reserves. For similar reasons, Guatemala, El Salvador, and Nicaragua also struggle to maintain numbers. Only in Costa Rica and Panama (and perhaps Honduras; surveys have been limited there) is the species still considered secure, with combined populations estimated at perhaps 50,000 individuals, thanks to large areas of protected forest in national parks. But, even here, the species may be at risk owing to loss of migratory habitat; each fall the quetzals leave highland forests to feed at lower elevations, where forests are often more fragmented.

While not an intensely studied species, broad outlines of this quetzal's life history are pretty well known -- mostly from research done in Costa Rica (Monteverde) in the 1980s and 90s, and in Mexico (Chiapas) 10-15 years later.

• Diet: these birds depend heavily on wild fruits, especially figs and the small, oil-rich drupes of trees in the family Lauraceae, relatives of the avocado.

• Nesting: pairs lay eggs and raise young in holes in rotting trees, often a scarce resource. Males and females share nesting duties (incubating eggs and feeding young), tasks that seem somewhat improbable for the gaudy males with their 3-foot long tail plumes. Many nests fail, eggs and nestlings falling prey to birds (especially toucans) and other predators.

I see the need to shine a spotlight on this elusive bird, increasing awareness of its fascinating life history and of how current trends in land use impact its habitat. To that end, I have signed a contract with Zona Tropical Publications to write a book on the Resplendent Quetzal, using Las Cruces as my base and nearby Las Tablas as my focus for observations. The timing seems good as land ownership at Las Tablas is currently in limbo. Promoting sustainable tourism there, focused on quetzals and other sought-after birds, could help protect this key habitat, and I can see Las Cruces providing direction and oversight if such plans gain traction.

De la Comunidad

La Ceiba Pequeña

Greg Nace / gana748@yahoo.com

Usually when an individual tree is planted in the Wilson Botanic Garden, it unceremoniously joins the thousands of other plants in the collection. However, there is one recent addition of special note.

Have you ever noticed that certain trees have an allure that seems to touch your heart and stir your inner spirit. These are the trees that whisper to your subconscious. They whisper in notes that flow into chords, and their tune somehow sticks. They imprint themselves as symbols for what we value and hold dear. The Ceiba tree (*Ceiba pentandra*) is one such trees. It has had a very special relationship to people of Costa Rica and Mesoamerica. In traditional cultures, the ceiba softly sings the mysteries of the universe. At present, there is one nearby tree of this species, which has come to represent a struggle to save a link to traditional cultures and our ecological underpinnings in the midst of rapid human development. It is La Ceiba in the town of Sabalito, about seven kilometers from the Garden.

La Ceiba stands as a fifteen story sentinel overlooking the tin and tile roofs spread below. Standing under La Ceiba and looking up, you see an enormous dome of glistening leaves, each one like an open hand. Among the leaves is a garden of epiphytic ferns, orchids and bromeliads whose seeds were deposited by countless winds and decades of birds resting on its branches. La Ceiba's enormous trunk supports a vibrant dome of life. Seeing the tree, you understand why the ancients called it the sacred Tree of Life. It is an allegory for life in all its glory. It symbolizes our relationship with nature, and gives us a sense of the breath and beauty of the divine.

When you realize how beautiful it is and wonder at its richness, you simultaneously grasp how fragile it is. This majestic ceiba overlooks an ancient nearby river, but it is a lonely oasis in a cage of civilization. A town has grown up around it, and in the name of progress, many have forgotten its significance. However, there are those that remember what the tree represents. They carry the spirit of tree in their heart and love the tree. They want to see it protected from careless encroachment.

One such person is Carla Azofeifa Rojas, a former employee of Las Cruces. At Las Cruces, she led educational programs at nearby schools. She is one who remembers the stories of the tree and the old growth forests, and has worked to save the tree. She knows La Ceiba has to be protected, not for the tree's sake, but for the sake of the children who may never see this magnificent tree or hear the magical and mysterious stories associated with it. She has been trying with others in the community to ensure the safety of the grand La Ceiba in Sabalito.

Carla arranged for a baby ceiba to be donated to the Wilson Botanical Garden. It was given to us with its roots in a simple plastic grocery bag, yet it was a tree born of noble lineage: it is the offspring of the ceiba in Sabalito, dug up by the owner of the plot where La Ceiba resides.

La Ceiba Pequeña is now thriving in the Garden where its roots can grasp the underworld and its crown can reach for heaven. It is located on the way to the Mirador. If a tree can be said to be happy, it is. It has grown to more than triple its size in two years. It is there to help the storytellers, like Carla, teach children to hear the whispers of the tree and respect human traditions, as well as the forests that carry these sacred traditions.

Dr. Gretchen Daily, a prominent ecologist, was so inspired by the whispers of La Ceiba that she wrote a wonderful book (One Tree by Gretchen C. Daily and Charles J. Katz) that retells some of the traditional stories together with this tree's alliance with its human and natural community. She chronicled how the community in the past rallied to save the tree. Those past efforts are to be lauded, but there are now reasons to once again rally to protect

Photo by Jeisson Figueroa

La Ceiba from its current threats. Unfortunately, the fate of La Ceiba in Sabalito hangs in the balance. After clearing the plot behind the tree, piles of debris are being dumped beneath it by the landowner, cutting off oxygen to the roots. Making matters more precarious, the vacant green plot on the left side of La Ceiba is for sale. A house could soon be built on top of its fragile roots. It would be shameful to let this grand old symbol of the richness of life disappear even though its offspring is secure within the Garden. If you are in a position to help with efforts to save La Ceiba, the local development association (ADI La Ceiba) can be contacted.

Neither my father nor my mother knew
the names of the trees
where I was born
what is that
I asked and my
father and mother did not
hear they did not look where I pointed
surfaces of furniture held
the attention of their fingers
and across the room they could watch
walls they had forgotten
where there were no questions
no voices and no shade

William S Merwin in "Native Trees"

Celebrating Roberto Burle Marx: One of the most influential landscape designers of the 20th century

Alison Olivieri / alison.w.olivieri@gmail.com

Roberto Burle-Marx: A talented man with a sense of humor. Photo from NYBG flier

A big announcement for all longtime 'Amigos': the New York Botanical Garden will present a multi-faceted exhibition of Roberto Burle Marx' work from June through September:

"Bronx, NY—The New York Botanical Garden (NYBG) will present Brazilian Modern: The Living Art of Roberto Burle Marx, an exhibition on influential Brazilian modernist artist, landscape architect, and plant explorer and conservationist Roberto Burle Marx, from June 8 through September 29, 2019. The first ever exhibition to combine a large-scale horticultural tribute to Burle Marx's design work and a curated gallery of his paintings, prints, drawings, and textiles, the show will reveal deep connections between his artistic practice and his commitment to environmental conservation.

"Visitors will discover Burle Marx (1909–94), a principal figure in the modernist art and garden movement in Latin America during the second half of the 20th century, and learn how his garden designs were fully integrated with his artistic work, his passion for botany and plant exploration, and his longtime leadership in plant conservation. The exhibition will highlight his boldly modern landscape 2 designs, executed in vibrant color and fluid geometric forms; his dynamic and influential works of art; and his celebrated contributions to horticultural exploration and plant conservation in his native Brazil."

Burle Marx was one of the original board members of the Wilson Botanical Garden and designed its beautiful Bromeliad Hill. This iconic view has been photographed by almost every visitor, being student, professor, employee, artist, volunteer and natural history traveler since the Wilson Garden was opened to the public, nearly 60 years ago. Bromeliad Hill showcases the enormous bromeliad *Alcantarea imperialis* along with a fan palm (*Licuala grandis*), both of which were Burle Marx' favorites and featured in many of his landscape designs. He is considered one of the most influential landscape architects of the 20th century in addition to his work as a plant conservationist and visual artist.

Any of our Amigos who live near New York should avail themselves of this in-depth exhibit of a fascinating personality. For those of you who do NOT live in or near New York: what a reason to make that trip!

More information can be found on the New York Botanic Garden website: www.nybg.org

As always, a big THANK YOU to you all!

Las Cruces Donors through March 2019

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***Licuala grandis.* Photo by Michael Olivieri**

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