

# Amigos

## *Newsletter*

No. 67, May 2007

©Julie Spratt



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



**Organization for  
Tropical Studies**

# Who We Are

The Las Cruces Biological Station is one of three tropical field stations owned and operated by the Organization for Tropical Studies (OTS) in Costa Rica. Along with the Wilson Botanical Garden, Las Cruces was acquired in 1973 and is a hidden jewel that 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 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 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 which include palms, aroids, bromeliads, ginger, marantas, heliconias, and ferns. More than 3,000 exotic species of plants can be found in the 12-hectare (~30-acre) garden, including one of the largest collections of palms in the world.

There is an incredible diversity of animals at Las Cruces, and in the immediate area surrounding the station. The most recently updated bird list includes 410 species, or close to half the number of birds found in all of Costa Rica. There are also over 100 species of mammals, of which 43 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 over 200 hectares of primary forest (home to over 2,000 native plant species) and smaller adjacent areas that are in various stages of forest recovery. The forest 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 see our website.

At approximately 1,100 meters elevation (3,300 feet), the prevailing temperatures at Las Cruces are cooler than an inexperienced traveler 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 December - April, 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, delicious meals, knowledgeable and enthusiastic staff, and a well-maintained network of pathways and trails. We can also provide Internet access to overnight visitors who

bring a portable laptop computer.

The nearest town to Las Cruces is San Vito which is the capital of Coto Brus County. It was settled in the 1950's by Italian immigrants and to this day there is a strong Italian presence. There is an excellent pizzeria, and the Dante Alighieri Italian-Costa Rican Community Center provides language instruction. Indeed Coto Brus is the only county in Costa Rica where Italian forms part of the elementary curriculum!

We invite you and your family and friends to come visit us for an afternoon, an overnight stay or a week to see and experience firsthand the splendid tropical diversity of the Las Cruces Biological Station and Wilson Botanical Garden.

*For more information please visit the Las Cruces website at [www.ots.ac.cr/en/lascruces/](http://www.ots.ac.cr/en/lascruces/) or contact us directly by email: [lcruces@ots.ac.cr](mailto:lcruces@ots.ac.cr). Postal mail can be sent to: Estación Biológica Las Cruces/Jardín Botánico Wilson, Apdo. 73-8257, San Vito de Coto Brus, Costa Rica. Telephone (from the U.S.): 011 (506) 773 4004.*

*Reservations can also be made by contacting the OTS office in San José by email: [nat-hist@ots.ac.cr](mailto:nat-hist@ots.ac.cr), postal mail: ESINTRO/OTS, Apdo. 676-2050, San Pedro de Montes de Oca, Costa Rica, or by telephone (from the U.S.): 011 506 524 0628.*

*The North American OTS office is located at Duke University, telephone: (919) 684 5774 or email: [nao@duke.edu](mailto:nao@duke.edu).*

*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 field 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.*

# Director's Keys and Notes

AMIGOS NEWSLETTER  
No. 67, May 2007

- 3 Director's Keys and Notes
- 4 What's New at Las Cruces
- 5 Research at Las Cruces  
Radio Tracking Tropical Forest Birds  
Arbuscular Mycorrhizal Fungi and Pasture Colonization by a Tropical Forest Tree  
Obituary: Bruce Haines
- 10 GIS Corner
- 11 Flora and Fauna  
A Collecting Expedition at Las Cruces  
An Amazing "Kodak" Moment
- 13 De la Comunidad
- 14 Our Donors  
Donations Update:  
Stretch you Dollar

**Front Cover:** Leaves of *Anthurium hoffmannii* at the Wilson Botanical Garden.

**Back Cover:** The rare double-headed Fiery-billed Aracari (*Pteroglossus frantzii*) posing for a photograph at Las Cruces. [There are actually two individuals sitting on the post!].

**Editorial Committee:** Tatiana Acón, Mariana Mora, Alison Olivieri, Rodolfo Quirós, Emilce Ramírez, Ariadna Sánchez, Zak Zahawi.

Zak Zahawi / zahawi@ots.ac.cr

Another Amigos newsletter has come and gone – how time flies! This one goes to press on the heels of a highly successful OTS board meeting that was held at Las Cruces at the end of March. The OTS board is comprised of the Assembly of Delegates (AoD) who are the representatives of each of the member University institutions, the Board of Directors (BoD), and the Board of Visitors (BoV) comprised of a US BoV and a Costa Rican BoV! In all, more than 70 board members visited the Station for the two-day meeting and for many, this was a first visit to Las Cruces as the last board meeting held at the station was almost 10 years ago! Board meetings usually discuss a variety of issues ranging from OTS course recruitment to issues relating to OTS governance, and include an overview of the financial status of the institution. This year the meeting was also very much focused on the implementation of the new 10 year OTS strategic plan (<http://www.ots.ac.cr/en/about/strplan.shtml>), finalized last year.

Aside from the general discussions that are always held at these meetings, this reunion also included a presentation and discussion of the future role of Las Cruces in tropical research and investigation. A concept paper was handed to the board outlining the main strengths of Las Cruces as a research station focused on the fields of conservation biology and restoration ecology given the fragmented landscape that surrounds it today. The presentation was well received and the ensuing debate outlined a number of working objectives that should promote the development of Las Cruces' research agenda for the next five years. They include increasing the land holdings of the Station to promote conservation and provide land for research in restoration ecology and biological corridors; developing

a restoration ecology workshop to be held at Las Cruces next summer to attract students, discuss the current state of the field, and coordinate activities among Las Cruces researchers; improve our research facilities (such as furthering the collections of the new herbarium), and develop agreements with local organizations and groups to help further conservation in the area (e.g. local reforestation organizations, the Guaymí indigenous community). All in all, the discussions were highly productive and motivating, and we at Las Cruces are now tasked with a strong and well supported research mandate!

On another note, and one that is directly related to the research agenda for Las Cruces, remember that the Land Campaign is well underway. In the last issue I had outlined the goals of this campaign and asked for help from our many Amigos. Many of you responded enthusiastically, both with contributions as well as with offers to help in the promotion of this project. I am happy to say that to date we have raised more than \$60,000 in contributions but we still have a long way to go! So if you are willing to help in some way, please do not hesitate to contact me. Note also that all the pertinent information relating to this project is now posted on the Las Cruces website along with color photographs and satellite images of the corridor region. Please direct anyone you know who might be interested in this campaign to the link listed below! The main Las Cruces website is <http://www.ots.ac.cr/en/lascruces/>, and from there click on the land campaign link.

I hope all of you are doing well and hope to see you again at some point in the near future along one of the Wilson Botanical Garden paths!

All the best,

Zak

# What's New at Las Cruces?

Zak Zahawi / zahawi@ots.ac.cr

## New Buildings



The front side of the new Visitor and Conference Center.

The new Visitor and Conference center building is well over half complete. It has been quite amazing to see the process unfold since the last issue of *Amigos* and we anticipate that it will be ready by July 2007. The building was expanded slightly from the original plans and the auditorium will now be almost 90m<sup>2</sup>. This space is large enough to be divided into two lecture rooms if the need arises, by means of a curtain partition. As I mentioned in the previous newsletter, the building will also house a new reception area and expanded gift shop, as well as several offices. All told, the building will provide almost 300m<sup>2</sup> of interior space. It is the first major construction to take place at Las Cruces in almost a decade and we are very excited about moving in!

On another note, I am very happy to report that the Stanley Smith Horticultural Trust funded our proposal to construct a new state of the art open-

air greenhouse on the main ground of the Wilson Botanical Garden. The greenhouse will be constructed on bromeliad hill near the second entrance gate. It will house all of our arid-zone plants that for many years have been hidden in a far corner of one of our maintenance greenhouses. Construction began in March of this year and we hope to complete construction within a few months. The planting and landscaping will take place once the greenhouse is complete and will require several additional months of preparation.



The Cactus Greenhouse under construction.

## Volunteer Time

Since the last issue of *Amigos* we have had help from a number of short-term volunteers. Melissa Arce, who I mentioned in the last issue has continued to help with the herbarium and we now have over 300 specimens processed. Sadly for us (!), she received an excellent new position at the EARTH institute, a non-governmental organization in the caribbean lowlands relatively close to La Selva. We wish her all the best.

A Canadian volunteer, Madeleine Denis, visited us in December and



Madeleine Denis teaching English to the staff of Las Cruces.

took on a rather novel task. She had experience teaching English as a second language and during her short stay here, had most of the Las Cruces staff in intensive English class during the afternoons. The experience was highly valuable to all who took part and we hope that Madeleine will come back again for the second unit!

As always, special thanks to our local volunteers who help in so many ways: providing garden walks to visiting groups, assisting with fundraising outreach, editing and distributing the *Amigos* newsletter, gardening, weeding and many other tasks. So a big "thank you" to all those volunteers from the greater Las Cruces area who help keep this place moving forward and a big thank you in particular to George Alexander Alcock, our most recent Volunteer Chef at the Garden, and his many kitchen assistants. It was another fantastic



# Research at Las Cruces

## Radio Tracking Tropical Forest Birds



dinner and this to our largest group thus far – 54 guests!

We always welcome volunteers. If you are interested in volunteering and learning more about what you can do to help at the Wilson Botanical Garden, please email us at [lcruces@ots.ac.cr](mailto:lcruces@ots.ac.cr).

### Tree Tour Booklet for Las Cruces

I am excited to report (because it took a very long time to put together) that we finally finished the Wilson Botanical Garden Tree Tour booklet in both Spanish and English. The self-guided tour is available for purchase from our gift store and takes you on a grand tour of 33 tree species that are found in the garden. The booklet showcases both native and exotic species and each description includes information about the tree's family, as well as detailed information about the specific species. Make sure to get a copy on your next visit and take the tour – it should take about 2 hours or so.



**The Orange-billed Nightingale-thrush (OBNT 976) of San Gabriel may be the world's only songbird that was radio tracked for five consecutive years.**

Cagan H. Sekercioglu / [cagan1@gmail.com](mailto:cagan1@gmail.com)

**T**ropical forests worldwide are being reduced to biologically impoverished remnants embedded in the agricultural countryside – human-dominated and mostly deforested areas consisting of croplands, pasture, gardens, second growth, and forest remnants (Daily et al. 2001). Even though human-dominated areas are the preferred habitat of 1% of the world's 9786 avian species (Sekercioglu et al. 2004), about one-third make some use of such habitats (Sekercioglu 2003). Given the high rate of tropical deforestation, the extent and ecological qualities of heavily deforested countryside will determine whether

some tropical forest species can persist in the absence of extensive forests. That, in turn, will affect the future of much biodiversity.

Understanding the persistence mechanisms of tropical forest species in human-dominated landscapes is a fundamental aspect of tropical ecology and conservation. Many species, including more than half of Costa Rica's native land birds, use mostly deforested agricultural countryside, but how they do so is poorly known. Do they commute regularly to forest or can some species survive in this human-dominated landscape year-round? The diverse agricultural countryside around Las Cruces Biological Station is ideal



birds with mist nets, banded them with color bands, and attached a transmitter to the back of each bird with skin-compatible eyelash glue. Transmitters have negligible effects on passerine welfare (Wells et al. 2003) and our transmitters were 3.6% of the average weight of each study species. After some preening in the first half hour, the birds resumed their usual behavior, flew and fed normally, and were not hindered by the transmitters. In 2003 we recaptured 31 of the birds we had tagged in 2002, and except for their leg bands, none showed any sign of having carried a radio tag. We tracked birds between 5AM and 10PM continuously except during episodes of heavy rain. On average, each bird was tracked for 45 hours distributed across 10 days.

In 2004 and 2005, we monitored 73 *Catharus*, 52 *Tangara*, and 60 *Turdus* nests using established protocol to minimize disturbance. At each study site, we surveyed the vegetation in 1764 fifty by fifty meter plots. We then compared vegetation preferences of our study species with the survey results. In various habitats at each site, we placed electronic data loggers to record temperature and humidity every minute, and to assign habitat temperature and humidity values to bird observations that occurred in those habitats.

We found that remnant trees, riparian strips, and small forest patches in agricultural countryside provided critical dietary, microclimatic, and nesting resources for our focal species. Forest remnants (forest fragments, riparian strips and remnant trees) were favored for foraging and nesting, especially during the dry season, because of their cooler and more humid microclimates. Our study species did not commute from extensive forest; rather, they fed and bred in the agricultural countryside. These birds exhibited two fundamentally different ways of dealing with the loss and fragmentation of their native forest habitat:

### Radio tracking in the Las Cruces agricultural countryside.

for investigating these questions, whose answers have crucial implications for the future of tropical conservation and habitat restoration.

Since June 2002, we have been conducting what may well be the most extensive radio tracking (telemetry) project on tropical birds. We have caught, color banded and radio tracked 426 birds of 11 species and collected over 30,000 GPS (Global Positioning System) locations detailing these birds' habitat use, movement, foraging, breeding, and survival patterns. In comparison, the average tropical bird radio tracking paper has under 1000 points on fewer than 20 individuals of one species. In combination with our intensive mist netting/bird banding since 1999 (over 30,000 individuals of 241 species captured at 18 sites covering six habitats) and nest monitoring since 2004 (over 250 nests of six species), multi-year radio tracking of Las Cruces birds is revealing key aspects of bird ecology. We have radio tracked dozens of individuals over multiple years, including an Orange-billed Nightingale-Thrush (*Catharus aurantirostris* or

*Catharus*) that was tracked for five years in a row, a record for a songbird.

We recently published (Sekercioglu et al. 2007) the findings of the first two years of radio tracking and nest monitoring of our three focal species, *Catharus* (low forest dependence), Silver-throated Tanager (*Tangara icterocephala* or *Tangara*, medium forest dependence), and White-throated Thrush (*Turdus assimilis* or *Turdus*, high forest dependence), based on data from 156 individuals, 8101 GPS locations, and 185 nests. These are forest birds that vary in their vulnerability to deforestation (Stiles 1985) and are representative of the species found both in forest and human-dominated landscapes.

For this paper, we tracked birds in 2002 wet and 2003 dry seasons, in four coffee-dominated landscapes (980-1080 m) ranging in tree cover (forest fragments, riparian strips, and remnant trees) from 5.1% to 14.2%. Because we wanted to understand persistence mechanisms of forest birds frequently found in the countryside, all birds were captured in partially-shaded coffee plantations, the most prevalent form of agriculture in the region. We caught

sedentary usage of agricultural areas and high mobility among forest remnants. *Catharus* adapted to coffee plantations and second growth. More forest dependent *Tangara* and *Turdus* spent most of their time in forest remnants, largely avoiding coffee plantations and other open habitats, even though all individuals were caught in coffee plantations. Although trees constituted only 11% of land cover, *Tangara* and *Turdus* spent 69% to 85% of their time in them.

The heterogeneous nature of the Las Cruces landscape and the high diversity of fruiting trees were important factors in the persistence of *Turdus* and *Tangara* in the countryside. *Catharus*, observed foraging on 14 plant taxa, was mainly insectivorous and mostly foraged on or near the soil. *Tangara* and *Turdus* mostly consumed fruits and foraged on 71 and 45 taxa respectively. Fruits of *Cecropia peltata*, *Syzygium malaccense*, and *Ficus* spp. were especially favored. *Catharus* individuals were found in the hottest and driest microclimate, *Tangara* preferred coolest and most humid conditions, and *Turdus* was intermediate.

*Tangara* and *Turdus* had bigger home ranges and greater movements. Adult predation was not a major source of mortality since only 5 out of 156 birds we radio tracked were preyed upon. Breeding success of *Catharus* and *Tangara* in deforested habitats was not different than in forest remnants, where *Turdus* experienced reduced breeding success. Nevertheless, benefits of higher breeding success in coffee plantations may be negated by lower fledgling survival in this habitat, as we observed during our pilot study in 2006.

Our Las Cruces radio tracking research is important in multiple ways. First, our findings have revealed the crucial value of small forest remnants, not just forest fragments, but also riparian strips and even individual trees, which were used

by more forest dependent study species 5 to 34 times more frequently than one would expect based on land cover. This shows that not only the Costa Rican law for protecting riparian forests is right on target, but also means that even modest habitat restoration that increases tree land cover by a few percentage points has disproportionate importance for native forest birds. Second, our project shows the importance of working with local research assistants, who have become expert radio trackers with unequalled knowledge of the terrain, and without whom our large sample sizes would have been impossible. Finally, the interesting twists and turns in avian demographics revealed by our diverse methods show the necessity, for effective conservation research, of long-term ecological monitoring that integrates a variety of techniques focused on all stages of avian life cycle.

The conservation value of working landscapes in the tropics can be boosted significantly with relatively little investment and conflict because remnant trees, riparian strips, forest fragments, and their residents also supply people and domestic animals with fruits, shade,

clean water, crop pollination, and other ecosystem services (Sekercioglu 2006). Tropical countryside has high potential conservation value, which can be enhanced with even modest increases in tree cover. Our findings have applicability to many human-dominated tropical areas that have the potential to conserve substantial biodiversity if appropriate restoration measures are taken. We hope that our multi-faceted approach will continue to uncover interesting and important aspects of bird ecology in the Costa Rican agricultural countryside and help guide effective tropical conservation efforts, and will solidify the standing of Las Cruces Biological Station in the annals of tropical conservation ecology.

#### Literature cited

- Daily, G.C. et. al 2001. Ecol. Appl. 11:1-13.  
Sekercioglu, C.H. 2003. Ph.D. dissertation. Stanford University, Stanford, California.  
Sekercioglu, C.H. et al. 2004 Proc. Nat. Acad. Sci. USA 101:18042-18047.  
Sekercioglu, C.H. 2006. Trends Eco. Evo. 21: 464-471.  
Sekercioglu, C.H. et al. 2007. Conservation Biology 21: 482-494.  
Stiles, F.G. 1985. pp. 141-170 in A. W. Diamond, and T. E. Lovejoy, eds. Conservation of tropical forest birds. ICBP, Cambridge, UK.  
Wells, K.M.S. et al. 2003. Condor 105:805-810.



The banding team hard at work.



## Arbuscular Mycorrhizal Fungi and Pasture Colonization by a Tropical Forest Tree

L. Aldrich-Wolfe / la17@cornell.edu

As visitors to Las Cruces and the Wilson Botanic Garden no doubt have noted, one striking feature of the local landscape is the abundance of pastures and the dearth of cattle. The region—with its high rainfall, calcium-poor soils, and steep terrain—is ill-suited for livestock, yet farmers are forced to turn to pasturage each time the global price for coffee takes a plunge. Pastures can serve as sites for reforestation and forest regeneration, if obstacles to re-establishment of forest plant species can be overcome. Some of these obstacles have been well-characterized—species that can not arrive in pastures because the animals that disperse their seeds will not venture into open terrain, species that are easily outcompeted by grasses in high light environments—while others remain poorly understood. For my dissertation work at Cornell University I considered how pastures may differ from forests belowground and the consequences of those differences for colonization of pastures by the tropical forest tree species *Terminalia amazonia* (Combretaceae).

While most of us are familiar with plants aboveground, far fewer of us have had the opportunity to study them below the soil surface. If asked how plants acquire nutrients, we most likely answer “through their roots,” blissfully unaware of our inaccuracy. In fact, most plants acquire many, if not all, of their essential nutrients (e.g. phosphorus, zinc, ammonium) not through their roots *per se* but through their mycorrhizas. Mycorrhizas are structures in plant roots, formed by the plant and its fungal partner, in which the plant feeds the fungus carbohydrates (derived from photosynthesis) in exchange for nutrients the fungus mines from the soil. There are many types of mycorrhiza. *Terminalia amazonia*, like most tropical plants, forms arbuscular mycorrhizas, an association with fungi in the phylum Glomeromycota. The arbuscular

mycorrhiza is an extremely old association between fungi and plants. Arbuscules, the structures that these fungi produce in plant cells and use to absorb sugars, have been observed in fossils of the earliest terrestrial plants. Arbuscular mycorrhizal (AM) fungi are obligate symbionts, meaning they can not grow in the absence of a plant host, and can typically disperse over only short distances, as they produce their spores belowground.

There are two ways in which forest conversion to pasture could influence AM fungi to the detriment of subsequent forest regeneration: 1) by causing a general decline in the abundance of AM fungi that results in less mycorrhiza formation in pastures than in forests, or 2) by shifting the composition of the AM fungal community toward species that fail to act as effective associates of forest plant species. To determine whether either of these processes occurs, I conducted a series of field studies at the pasture-forest interface on three farms in the community of Siete Colinas (15 km north of Las Cruces) with the help of two local field assistants, Oldemar Cascante Arrieta and Verónica Delgado Jiménez. At each farm, we established two research plots, one in a forest fragment and one in immediately adjacent pasture. We collected soil samples in the six plots in

the rainy and dry seasons for three years, and I sieved the samples for spores of AM fungi. From a total soil volume of six liters, I recovered and identified 26,915 spores, representing 38 species of AM fungi. There are currently roughly 160 described species of AM fungi worldwide. In other words, at my research site I observed a richness of species comparable to 1/5<sup>th</sup> of all known species! Nine of the species I observed have yet to be described.

I found that spores of AM fungi were generally more abundant in pasture than in forest soils, suggesting that forest plant species arriving at pasture sites are unlikely to experience a general decline in availability of AM fungi relative to that of forested sites. However, the species of AM fungi that forest plant species are likely to encounter differ between forest and pasture sites. While 17 of the 21 species that I frequently encountered in soil samples were shared between forest and pasture, three of the four most abundant species observed in pasture were never observed in forest. Whether these species are effective mycorrhizal associates of forest plant species remains to be tested.

To examine the effect of belowground communities on seedling establishment in pastures, we established a reforestation plot



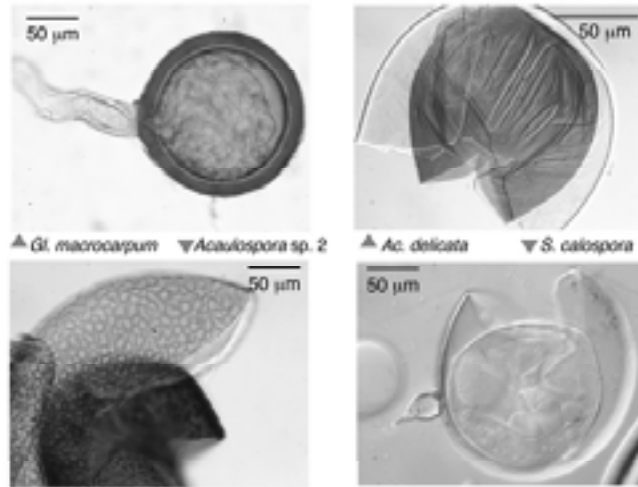
Cileny Cascante and Verónica Delgado record data on growth of two-year-old saplings of *Terminalia amazonia* (amarillón) in pasture reforestation plot.



on each farm with *T. amazonia* seedlings inoculated with either forest or pasture soil. We collected seeds from local trees, germinated them in flats containing forest or pasture soil, and transferred the resulting seedlings to planting bags again containing either forest or pasture soil. After four months, 50 seedlings from each soil inoculum type were transferred to each of the reforestation plots. We documented seedling survival, growth and root colonization by AM fungi for two years.

We observed considerable mortality of *T. amazonia* in the reforestation plots. Half to two-thirds of the seedlings in each plot died during the course of our study. Mortality was consistently lower among seedlings inoculated with forest soil relative to seedlings inoculated with pasture soil. We did not observe differences in growth of seedlings. Root colonization by AM fungi at the time of planting was higher for seedlings inoculated with forest soil than seedlings inoculated with pasture soil, but did not differ between the two seedling types after five months in the plots. Soil nutrient analyses and the observation that growth did not differ indicate that nutrient availability was not an important difference between the soil inocula. The reduced levels of root colonization by AM fungi in seedlings grown in pasture soil, coupled with differences in seedling survival, suggest that the pasture community of AM fungi may consist of less effective fungal associates of *T. amazonia* than the forest community.

To test this hypothesis directly, I germinated 48 seedlings of *T. amazonia* in sterile soil under greenhouse conditions, inoculated them with either 1) 60 spores of forest AM fungi; 2) 60 spores of pasture AM fungi; or 3) no AM fungi, harvested them after six months and measured their biomass, root colonization by AM fungi and shoot nutrients. I found that on average 66% of a seedling's root system



**Spores belonging to four species of AM fungi found in this study.**

was colonized by AM fungi for seedlings inoculated with forest AM fungi, while only 19% of the root system was colonized for seedlings inoculated with pasture AM fungi (seedlings inoculated with no AM fungi were not colonized). Differences in root colonization were reflected in seedling nutrient acquisition and growth. At harvest, seedlings inoculated with forest AM fungi contained twice as much phosphorus in their shoots and were twice as large, on average, than seedlings inoculated with pasture AM fungi. Although seedlings

inoculated with pasture AM fungi contained slightly more phosphorus than uninoculated seedlings, they were indistinguishable from uninoculated seedlings in their biomass. While pasture AM fungi were able to colonize this forest plant species, they appear to have failed to provide any benefit to their hosts.

Taken as a whole, the results of my dissertation work suggest that the shift in the AM fungal community as a result of forest conversion to pasture may affect the extent to which forest plant species such as *T. amazonia* are able to recolonize pasture sites. The degree to which changes in the mycorrhizal community can limit colonization of pastures by forest plant species urgently requires additional studies, incorporating more of the AM fungal species that are unique to pasture sites and testing the effects of the altered AM fungal community across a range of forest plant species. In conserving tropical biodiversity, the importance of investigating and conserving belowground organisms such as mycorrhizal fungi must not be overlooked.

## Obituary: Bruce Haines

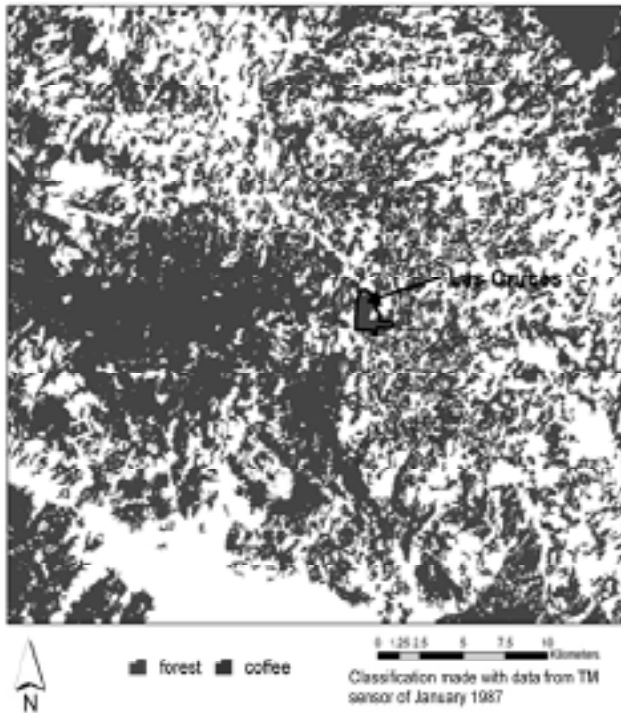
Zak Zahawi / zahawi@ots.ac.cr

We are sad to report that Bruce Haines, a long-time researcher at Las Cruces Biological Station, passed away on February 16th 2007. Bruce was a plant ecologist at the University of Georgia and dedicated his life to teaching botany and doing related research in ecosystem ecology. He and Chris Peterson, a fellow researcher from UGA, established permanent plots in five pasture sites adjacent to forest fragments on the Cerro Paraguas ridge in the mid 1990s. The project continues to this day and several important publications have emerged from it. Bruce visited LCBS on many occasions and over the years developed close relationships with station staff. He became very devoted to the station and was always looking for ways to help us grow. He will be missed here but his presence will live on through the research and discoveries that he contributed to further our understanding of ecological processes at Las Cruces. A tree will be dedicated to his memory on the Wilson Botanical Garden grounds.



## GIS Updates at Las Cruces

Guillermo Durán / [gduran@ots.ac.cr](mailto:gduran@ots.ac.cr)



Map of land use classification in 1987. The white areas are a mixture of pasture, African palm plantations, unclassified agricultural fields, and urban areas.

The Las Cruces GIS Lab has been busy analyzing the remote sensing data we have gathered recently. We chose a small area to conduct software experimentation, about 15 km around the Station, because this is where most of the research is conducted and because it includes the Guaymí Indigenous Reserve.

We started with the oldest images we could find, from the years 1979 and 1987 to map the extent of forest, coffee, and pasture. For this analysis we used the historical aerial photographs as a way to train the software to discern between the different land uses.

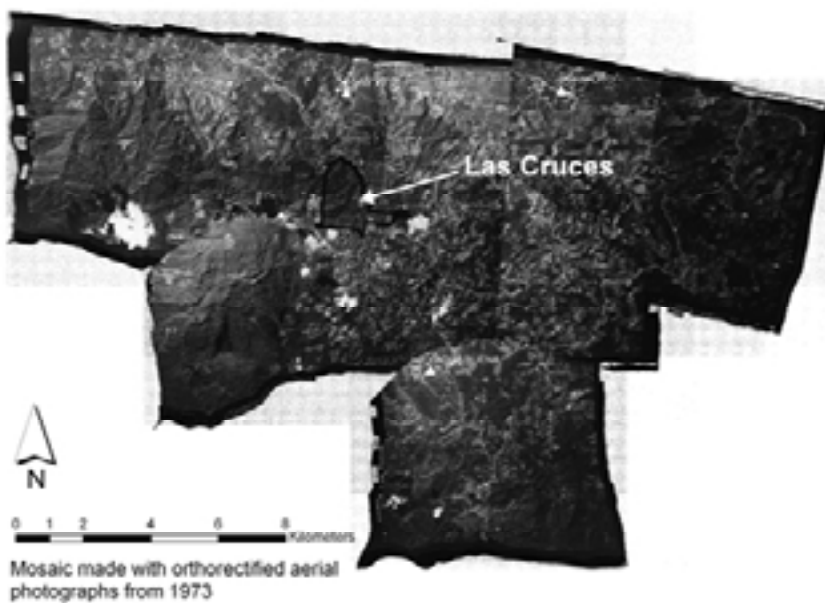
We hope to merge this information with some completed by CATIE graduate student Margarita Céspedes and FONAFIFO – University of Alberta, so we could have land cover maps from 1979 to 2006. With this data it will be possible to measure, from a broad scale, the changes that have occurred in the landscape around us.

We have also increased the area covered by the historical aerial photographs to have information on a finer scale than what we have from the satellite images. In pursuit of these historical photographs, we have visited the Instituto Geográfico Nacional in San José several times, where we were able to obtain images from three more years: 1960, 1973 and 1981. We hope someday to have all our study area covered by these historical photographs, but it is a very slow process.

This information is of key importance for much of the research done at the Station, because the old photographs make it possible to know the history of all the forest fragments around Las Cruces since its isolation began.

At this time, we seek help in acquiring the license for a good remote sensing software package like ENVI or ERDAS Imagine to allow us to continue our analysis of the data we have gathered. Any help from the Las Cruces *Amigos* would be greatly appreciated!

Finally, the OTS GIS Labs had their first meeting at the La Selva Biological Station. The GIS lab managers from Las Cruces, La Selva, and Palo Verde talked about ways to facilitate lab interaction, standardize the data, website information and more. We will have one of these meetings every six months and we hope to host the next one here at Las Cruces.



Aerial view of landscape around Las Cruces in 1973.

# Flora and Fauna

## A Collecting Expedition at Las Cruces



Ariadna Sánchez.

**Rick Phillippe examining a bundle of flowering branches.**

Zak Zahawi / [zahawi@ots.ac.cr](mailto:zahawi@ots.ac.cr)

Last January eight botanists and one mycologist visited Las Cruces for a 10-day collecting expedition. This was one of the first such explorations organized at Las Cruces in many years and it was a tremendous success. The project was a joint development between the Illinois Natural History Survey and Las Cruces that was planned and developed over a period of some six months. I knew many of the collectors from my days as a graduate student at the University of Illinois where I worked part-time in the Illinois Natural History Survey (in fact one of the botanists

was my former boss!); whereas a couple of others had taken the OTS Tropical Systematics course the previous summer.

Back to the expedition: unfortunately for me, January was a particularly busy month and I couldn't go into the field with the group nearly as many times as I would have liked to. The first day of collecting after arriving at Las Cruces was particularly bad and much as I would have liked to I couldn't accompany them. Alas – with great fanfare they set off toward the Rio Java trail with all having ordered pack lunches and ready to spend the entire day in the field. I was very envious of the excursion and I envisioned they might get into a nice section of the primary forest by the time they called it a day. In reality though what happened was completely different! Far from delving into the depths of the Las Cruces forest, the team got stuck within the first 50 m of the Rio Java trail! Apparently they had found so many things to collect within that area that they ended up eating their pack lunches within full view of the botanical garden! Obviously I could have easily paid them a visit if I had only known!

Most days were spent collecting in the Las Cruces forest but they also spent one day collecting in the fragments that form part of the proposed Las Cruces

corridor where we found some important highland specimens. Another day we all traveled to Las Alturas – a private forest reserve abutting the La Amistad Biosphere Reserve about 20 km from the station. The forest there is spectacular and, apart from a vicious attack by chiggers (we were all scratching for a week after that trip), many fantastic and interesting specimens were collected in what is a truly magnificent forest.

By the time the expedition left, approximately 500 new plant specimens had been added to the Las Cruces herbarium and likely an equivalent number of fungi – although that has yet to be determined! It was sad to see the team leave after having their company for so many days, but hopefully this will serve as the first of many expeditions to Las Cruces. That way we can slowly increase our herbarium collection and determine with greater certainty what species we have represented in our forest and surrounding areas.



Ariadna Sánchez.

**Pressing plants in the field.**



Julie Girard.

A Black-and-White Hawk-Eagle seen at Las Alturas on March 1, 2007.

## An Amazing “Kodak” Moment

Alison Olivieri / maoawo@aol.com

Julie Girard, a neighbor, supporter and valued volunteer of the Wilson Garden, photographed a rare and spectacular bird recently at Las Alturas de Coton: a Black-and-white Hawk-Eagle, *Spizastur melanoleucus*, identified by ornithologist Jim Zook.

The photo was taken on March 1, 2007 during a San Vito Bird Club trip to the remote and beautiful area where OTS has access to a biological station for student visitation and research.

An avid birder and photographer, Julie is the Vice President of the SVBC and has been an active participant in that organization’s Avian Monitoring Project with Principal Investigator Dr. Steve Latta of the National Aviary in Pittsburgh, PA. This long-term study is a collaboration involving NGO’s Point Reyes Bird Observatory and the Connecticut Audubon Society, as well as the Asociación Ornitológica de

Costa Rica and Partners in Flight of Mesoamerica.

As one of the co-investigators, she organizes a minimum of three mist netting sessions per year at three privately-owned sites, coordinates volunteers from Costa Rica and the US, and is responsible for the project’s information database as well as all project photography.

With her husband, Dave Woolley, Julie lives in Toronto from May through October and migrates to San Vito in November each year, following the same schedule as the neotropical migrant birds she studies here! Julie leads Wilson Walks twice a month with her San Vito Bird Club hat on and steps in to guide Las Cruces natural history visitors in addition to serving on the committee for Las Cenas Internacionales, special fundraising dinners held three times a year to augment the Wilson Garden/Las Cruces Annual Fund.



# De la Comunidad

## Environmental Outreach and Education

Ariadna Sánchez / [asanchez@ots.ac.cr](mailto:asanchez@ots.ac.cr)

For over forty years OTS has been one of the most important institutions for tropical research and, as “the classroom of the tropics”, carries out a very important role in the education and generation of scientists, professionals, and policymakers. At present, and to continue working on its mission of providing leadership in education, research, and the responsible use of natural resources in the tropics, OTS is adding in a new strategic direction of environmental outreach and education.

An Outreach Committee was created at the organization level, which has as a main objective to interpret and make available the research results of all these years in such a way that it is accessible and easily understandable by the general public, and especially the local communities. The committee also aims to develop and follow a “green ethic” as a basic principle for every action undertaken.

In the specific case of Las Cruces, the Environmental Program has been gaining strength. Among the activities proposed in order to achieve a stronger connection with the local communities are to develop a series of lectures, workshops, and field activities addressed to different audiences – from young elementary school and high school kids to university groups, rural associations, farmers, institutions, and others. The different topics that will be offered range from general aspects of ecological processes, to biodiversity and natural resources conservation, to more specific themes such as taxonomy, solid and liquid waste management, and forest fragmentation. Those topics were chosen according to the needs identified in a general assessment and evaluation with the local people.



The muppets of Las Cruces pose for a photograph with their forest fragment in the background.

Another priority of this program is to train local tourist guides. At the moment there is an organized youth group from the town of Agua Buena that has a project called “Proyecto Distrito Ecológico Saludable y Seguro”. Besides working on environmental activities, they are interested in ecotourism and most of them come from a bilingual high school. In addition, some of the JOMMA (Jóvenes Organizados para un Mejor Mañana) group members from Copal have been working as field research assistants. Our task is to enhance even more the interaction between researchers and the local community. As part of this program we are beginning to promote a puppet workshop and club, which will be a creative tool to motivate the general

public to become part of the overall outreach program.

At the internal level we created a project called “Pizarras Informativas” or “Informative Blackboards”, where we present different topics of interest such as environmental celebrations like Water Day, Environmental Week, Tree Day, and so on. Additionally, during low season we will initiate a training program for the staff and give lectures and other activities about environmental issues.

The ultimate aim of this outreach and environmental education program is to provide a forum for the reflection and discussion of principal environmental problems in the area, and help the communities make their own decisions on how to solve them.

# Our Donors

## Donations Update: Stretch Your Dollar

Alison Olivieri / maoawo@aol.com

We are pleased to announce that the Metzack family, whose children raised \$150.00 selling lemonade and outgrown toys for our Land Acquisition Campaign, must have inspired readers of the Amigos newsletter! We have now received more than \$60,000 for this critical initiative undertaken by Station Director Zak Zahawi and explained in detail in the last issue, No. 66, November 2006.

In addition, we are thrilled to see many donations in Memory of George H. Alcock, a cherished neighbor of Las Cruces for the past six years; gifts for the Campaign to Honor Luis Diego Gómez, Director of the Wilson Botanical Garden and Las Cruces for nearly two decades; contributions in Memory of Elizabeth Van Pelt, an enthusiastic natural history visitor, and even one donation made in Honor of the San Vito Bird Club!

Our theme for this article is “*S-T-R-E-T-C-H Y-O-U-R D-O-L-L-A-R*”! And how might you do that? The answer is: simply by making a donation to the Wilson Botanical Garden and Las Cruces Annual Fund.

Most of our loyal supporters already know how far their generous gifts really go here in southern Costa Rica. Ponder this: a \$100 annual donation -- generous by any standard -- might help purchase a calculator in Colorado but here it represents a week's salary plus health benefits for a full-time gardener.

Keeping Las Cruces in tip-top shape requires the services not only of gardeners,



George Alexander Alcock (left) and Linda and Doug Wilson take a moment's rest on the new bench in Memory of George H. Alcock placed near a flourishing, young *Ceiba pentandra* that was donated by George Alex in 2005.

but housekeepers, the beloved kitchen ladies, administrative personnel, resident biologists, accountants, librarians, research assistants and more. It is a never-ending work ethic meeting the needs of visiting college students, researchers, natural history visitors and specialized groups.

This year our goal for the Annual Fund is \$45,000. To date we have raised over \$22,000. Clearly, we need your help now more than ever so PLEASE take a moment to fill in the enclosed donation form and send as generous a donation as you possibly can. We will put it to good use, I can promise you that!

# *Amigos, many thanks to all!!*

**(Donations through February 2007)**

## **Annual Fund Supporters**

Lowell & Patricia Adams  
 Marie & Donald Adamson  
 John & MaryAnne Aspinall  
 Elizabeth P. Atkins  
 Steven J. Baer  
 Robert & Nancy Baldwin  
 Peter & Joan Banks  
 David & Jane Bates  
 Patty & Clark Blake  
 Doug & Lee Buckmaster  
 Teresa & Othon Bueno  
 Dr. Leslie J. Burlingame  
 Jean V. Carley  
 Lynne Carmichael  
 Jeff Cassens  
 Grant Cummings  
 Albert M. Cutler  
 Gretchen Daily & Gideon Yoffe  
 Gilbert & Emily Daniels  
 Muriel E. Danon  
 Thomas R. Davis & Ellyn Bush  
 Dr. Jean B. Deinhardt  
 Curtis & Angela Dowling  
 Anne & Paul R. Ehrlich  
 Robert Eigelberger  
 David & Audrey Fielding  
 Dr. & Mrs. Gordon W. Frankie  
 Mark Friedrich  
 Julie A. Gibson  
 Richard H. Goodwin  
 David & Julia Grambort  
 Antony Haralambos & Aliko Thomas  
 Gary Hartshorn  
 Carolyn & Mary Heler  
 Richard & Ann Hennessey  
 Hercules Incorporated  
 Walter & Barbara Hodge  
 Richard & Jean Hoffman  
 Scott & Joan Holt  
 David C. Husband  
 Jeffrey R. Kapela

Rachel & Thomas Kellerman  
 William & Bonnie Kemp  
 David S. Kiefer  
 Peggy Klenz  
 Lynn & Carl Leopold  
 Dr. Catherine A. Lindell  
 Theresa Margherita  
 Albert & Elsie Matlack  
 Brenda P. McGowan  
 Bert McIntosh  
 Helen McKenna & Allan Riddey  
 David & Esther McLaughlin  
 Kathryn K. McNeil  
 Lawrence & Helga Merryman  
 Julie Nader  
 Margaret A. Neighbors  
 Jon & Max Nygaard  
 Dr. & Mrs. Lawrence Palkovic  
 Brian & Carol Parker  
 Ward Patrick  
 Thomas Peacock  
 Doris P. Petrochko  
 Vincent A. Puglisi  
 Marie W. Ross  
 Jack & Jean Sargent  
 Joseph & Rene Schall  
 Patricia J. Scott  
 Lester Short & Jennifer Horne-Short  
 Betty Gayle Smith  
 Richard & Mary Smythe  
 Alton E. Speed  
 Glenn Spencer & Teresa Fanucchi  
 Allen Thoma & Diane Fong  
 Tracy Thompson  
 Dr. and Mrs. Robert C. Tweit  
 Joyce Marie Varelmann  
 Leslie A. Walker  
 Dr. T. Edward Weiss, Jr. &  
 Ms. Marcia Stefani  
 Dr. & Mrs. Joseph F. Wethington  
 Douglas & Linda Wilson  
 Stuart & Laura Wilson

Donald E. Wiseman  
 David Woolley & Julie Girard  
 Aracelly & Nikolas Zakharoff

## **In Honor of Elizabeth Van Pelt**

Alison & Michael Olivieri  
 Stephen C. & Laura Tulley

## **The George H. Alcock Fund**

Lucretia & Andrew DeCaro  
 Marcel & Monique Girard  
 Franklín Leal Herrera  
 Terrie & Tom Moss  
 Alison & Michael Olivieri  
 Stuart & Judy Richardson  
 Frederick & Jean Schroeder  
 Douglas & Linda Wilson  
 Julie Girard & David Woolley

## **The Luis Diego Gómez Fund**

Dr. James L. Hamrick  
 Dr. & Mrs. Bryan A. Hanson

## **The Land Campaign Fund**

Steven John Baer  
 Robert & Nancy Baldwin  
 Lynne Carmichael  
 David & Frances Coleman  
 Richard H. Goodwin  
 Roberta Gutman  
 Walter & Barbara Hodge  
 Pamela A. Maher  
 Virginia A. Matzek  
 Ana Pilar Morales Pérez  
 Jack & Jean Sargent  
 Patricia J. Scott  
 Margaret & Fred Sibley  
 Alton E. Speed  
 Robert & Mary Von Eschen



© Zak Zahawi



Las Cruces Biological  
Station & Wilson  
Botanical Garden  
Apdo 73-8257  
San Vito, Coto Brus,  
Costa Rica.



Here is my donation  
**to support Las Cruces**



**Organization for  
Tropical Studies**

NAME:

ADDRESS:

CITY/STATE/ZIP:

E-MAIL:

PHONE:

**PAYMENT INFORMATION**

- CHECK ENCLOSED    CHARGE MY    VISA    MASTERCARD  
 CASH                      \$ \_\_\_\_\_

CARD NUMBER

EXP DATE

SIGNATURE

Please mail this form with your check (made out to OTS) or credit card information to:

**Las Cruces Biological Station. P.O. Box 73-8257 San Vito. Coto Brus, COSTA RICA**  
or **OTS. Box 90630. Durham, NC 27708-0630**

**I (WE) WANT TO HELP WITH  
A GIFT OF:**

- \$50                       \$1,000  
 \$100                     \$5,000  
 \$250                     \$10,000  
 \$500                     Other

**I (WE) WOULD ALSO LIKE TO  
CONTRIBUTE TO THE LAND  
CAMPAIGN WITH A GIFT OF:**

- \$100                     \$5,000  
 \$250                     \$10,000  
 \$500                     Other  
 \$1,000

**Remember! To donate is to  
invest in the things that you  
believe in and the changes  
you want to make**

- Las Cruces is home to over 2000 native plant species, 3000 species of plants from all over the world, and over 400 species of birds.
- With the most important botanical collection in Central America, Las Cruces has attracted and enchanted visitors and researchers alike for over 30 years.
- Become an *Amigo* by making your tax-deductible contribution today. Thanks to the support of people like you we can maintain this incredible biodiversity!

**Please indicate whether you want your *Amigos* mailed electronically (pdf format)**

No  
Email \_\_\_\_\_

Yes



© J.J. Pucci.

## **Benefits**

All of our *Amigos* receive benefits for their donations including a yearly subscription to the *Amigos* newsletter. For more information please write to [cmzell@duke.edu](mailto:cmzell@duke.edu) or [lcruces@ots.ac.cr](mailto:lcruces@ots.ac.cr)

As a 501 (c) 3, gifts to the Las Cruces Biological Station are tax-deductible in the U.S. and Canada to the fullest extent allowed by law.