Botany of The Los Amigos Conservation Area

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C O N N E X I O N S

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BOTANY OF THE LOS AMIGOS CONSERVATION AREA

RÍO LOS AMIGOS MADRE DE DIOS, PERU

Table 1

- John P. Janovec, BRIT & ACA

[1] This content is available online at <http://cnx.org/content/m11602/1.1/>.

- Fernando Cornejo, ACCA & BRIT
- Mathias Tobler, TAMU Spatial Sciences Laboratory & BRIT
- Amanda K. Neill, BRIT
- Piher Maceda, ACCA & BRIT

With contributions from a growing list of collaborators:

- Scott A. Mori (The New York Botanical Garden)
- Piers Majestyk (The New York Botanical Garden)
- Robin Foster (Chicago Field Museum)
- Carlos Reynel (La Molina University Forestry Herbarium, Lima, Peru)
- Hamiltòn Beltrán (San Marcos Herbarium, Lima, Peru)

Chapter 1

Introduction

1.1 An introduction to the Botany of the Los Amigos Conservation Area[1]

Introduction to the Botany of the Los Amigos Conservation Area Project John Janovec The Botanical Research Institute of Texas

1.1.1

1.1.1.1 Introduction

The Amazonian wilderness harbors the greatest number of species on this planet and is an irreplaceable resource for present and future generations. Amazonia is crucial for maintaining global climate and genetic resources, and its forest and rivers provide vital sources of food, building materials, pharmaceuticals, and water needed by wildlife and humanity.

The Los Amigos watershed in the state of Madre de Dios, southeastern Peru, is representative of the pristine lowland moist forest once found throughout most of upper Amazonian South America. Threats to tropical forests occur in the form of fishing, hunting, gold mining, timber extraction, impending road construction, and slash and burn agriculture. The Los Amigos watershed, consisting of 1.6 million hectares (3.95 million acres), still offers the increasingly scarce opportunity to study rain forest as it was before the disruptive encroachment of modern human civilization. Because of its relatively pristine condition and the immediate need to justify it as a conservation zone and as a corridor between Manu National Park and the Tambopata-Candamo Reserved Zone, this area deserves intensive, long-term projects aimed at botanical training, ecotourism, biological inventory, and information synthesis.

On July 24, 2001, the government of Peru and the Amazon Conservation Association, represented by Enrique Ort?z, signed a contractual agreement creating the first long-term permanently renewable conservation concession. To our knowledge this is the first such agreement to be implemented in the world. The conservation concession protects 340,000 acres of old growth Amazonian forest in the Los Amigos watershed which is located in southeastern Peru. This watershed protects the eastern flank of Manu National Park and is part of the lowland forest corridor that links it to Bahuaja-Sonene National Park. The Los Amigos conservation concession will serve as a mechanism for the development of a regional center of excellence in natural forest management and biodiversity science. Some overall goals of the Los Amigos Conservation Area program are to:

- Protect the Los Amigos watershed;
- Develop a world-class research center and model private protected area;

[1] This content is available online at <http://cnx.org/content/m11585/1.2/>.

- Train a new generation of Latin American ecologists and resource managers;
- Create sustainable economic and social benefits for the local populations;
- Develop new watershed conservation models for Amazonian eco-development;
- Develop new ecosystem management understanding and practices;
- Monitor and compare the ecological health of pristine ecosystems versus those experiencing logging, mining and agricultural disruption;
- Empower a cadre of Peruvians who will act as the long-term guardians, mentors, planners and conservation actors in the region.

1.1.1.2 Initiation of the Botany of the Los Amigos Conservation Area Project

Several major projects are being implemented at the Los Amigos Conservation Area. Louise Emmons is initiating studies of mammal diversity and ecology in the Los Amigos area. Other projects involve studies of the diversity of arthropods, amphibians, reptiles, and birds. Robin Foster has conducted botanical studies at Los Amigos, resulting in the labeling of hundreds of plant species along two kilometers of trail in upland and lowland forest. Los Amigos has also been a major field site for Robin's rapid identification laminated photographic field guides to tropical plants. Michael Goulding is leading a fisheries and aquatic ecology program, which aims to document the diversity of fish, their ecologies, and their habitats in the Los Amigos area and the Madre de Dios watershed in general.

With support from the Amazon Conservation Association, and in collaboration with US and Peruvian colleagues, the Botany of the Los Amigos project has been initiated. At Los Amigos, we are attempting to develop a system of preservation, sustainability, and scientific research; a marriage between various disciplines, from human ecology to economic botany, product marketing to forest management. The complexity of the ecosystem will best be understood through a multidisciplinary approach, and improved understanding of the complexity will lead to better management. In essence, we must be informed to make wise management decisions about Amazonian forests. These forests hold the greatest number of species on our planet and are an irreplaceable resource for present and future generations. The future of these forests will depend on sustainable management and development of alternative practices and products that do not require irreversible destruction.

The botanical project will provide a foundation of information that is essential to other programs at Los Amigos. By combining botanical studies with fisheries and mammology, we will better understand plant/animal interactions. By providing names, the botanical program will facilitate accurate communication about plants and the animals that use them. Included in this scenario are humans, as we will dedicate time to people-plant interactions in order to learn what plants are used by people in the Los Amigos area, and what plants could potentially be used by people.

To be informed, we must develop knowledge. To develop knowledge, we must collect, organize, and disseminate information. In this sense,botanical information has conservation value. Before we can use plant-based products from the forest, we must know what species are useful. We must know what their names are in order to be able to communicate accurately about them. We must be able to identify them, to know where they occur in the forest, how many of them exist, how they are pollinated and when they produce fruit (or other useful products). Aside from understanding the species as they occur locally at Los Amigos, we must have information about their overall distribution in tropical America in order to better understand and manage the distribution, variation, and viability of their genetic diversity and germplasm. This involves a more complete understanding of the species through studies in the field and herbarium.

1.1.1.3 Main Collaborators

- John Janovec, The New York Botanical Garden
- Fernando Cornejo, ACCA, Puerto Maldonado, Peru

1.1.1.4 Advisors and Collaborators

- Scott Mori, The New York Botanical Garden
- Robin Foster, Chicago Field Museum
- Adrian Forsyth, ACA & Moore Foundation
- Michael Goulding, ACA
- Louise Emmons, National Museum of Natural History, Smithsonian Institution & ACA
- Hamilton Beltran, San Marcos Museum, Herbarium, Lima, Peru
- Douglas Daly, The New York Botanical Garden

1.1.2

1.1.2.1 Site Information

Visit the Site Information link to find out more about the Los Amigos Conservation Area and Research Station. Important imformation and useful maps are provided for viewer reference. In addition, you can visit the Amazon Conservation Office website for more information (www.amazonconservation.org).

1.1.2.2 Databases

The databasing system is a very intricate part of the botanical project. When plants are collected in the field, information is recorded in the database for each collection. This information relates to characteristics of the location, habitat, and the plant. Images are also databased. Filemaker Pro 5.5 is being used as the central database for organizing and outputting data collected through field and herbarium study. From Filemaker Pro, we can produce paper documents such as descriptions, lists, and specimen labels. We can also export to MS Excel or MS Access for performing tasks related to web database search engines, mapping, statistical analysis, etc. MS Access is used as a bridge between Filemaker Pro and the Internet. As the botanical database for Los Amigos grows, and as it eventually combines with databases for Madre de Dios and the southwestern Amazon in general, the Internet search engine will be updated. Available for current searching are plant lists from Robin Foster and Hamilton Beltr?n plant list. In the next month, a database of plant collections made since May 2001 will be made available, and this will be connected to the Image Galleries, which are also database-driven.

1.1.3

1.1.3.1 Image Galleries

Image galleries will be available in several formats and at several levels throughout these pages. First of all, each family, genus, and species page will be associated with their own database-driven galleries. The current version of the Image Gallery section is designed as a general hub for viewing all images that have been digitized. For now the images are organized into a few general categories and the searches provide access to browsable lists of images. Currently there are 1029 images available in the gallery. The images were scanned from Fuji Provia and Kodak film 35 mm slides. Dreamweaver Ultradev is used to generate the image search engine.

1.1.4

1.1.4.1 Future Direction

The first phase of the botanical project focuses on general exploration of the Los Amigos Conservation Area as well as useful plant-based non-timber forest products, and the preparation of checklists and other treatments covering the flora of the area. We believe that the botany program will provide an essential foundation for other scientific projects in the short and long-term. Plant guides will serve as informative tools for building

the long-term program of research and conservation at Los Amigos. Our botanical work will also provide information about useful plants that may prove to be sustainable non-timber forest products.

This website is meant as a source of information and images for the Botany of Los Amigos project. Digital identification keys, an expanded database, and plant family web pages will be posted soon. The plant family pages will include genus and species pages. The information, images, and tools will be made available on CD-ROM, used at The Los Amigos Research Station by students, locals, and investigators, and presented on the Internet through this site.

1.1.5

Go to next page: Site Information

Chapter 2

Information

2.1 Area and Location of the Los Amigos Conservation Area[1]

2.1.1 Area and Location

The Los Amigos Conservation Area is in Madre de Dios, Peru, and encompasses approximately 140,000 hectares (ca. 400,000 acres) of forest.

The Los Amigos Research Station sits at about 270 m above sea leave and is located at (degrees.minutes.seconds): 12.34.173 S and 70.06.069 W. The station consists of several hundred hectares of property with 35 km of trails that wind through about nine different habitat types, from high terrace forest to palm swamp to flooded forest. There are two private cabins, a dormitory, a two-story tent/hammock shelter, a shade-house plant nursery, cookhouse, and a cafeteria that can handle about 50 people. A canopy walk stretches off of the high terrace forest into the canopy of a towering Brazil nut tree (*Bertholletia excelsa-Lecythidaceae*). The station is powered by solar and hydroelectricity, with limited use of a gas-powered generator. The water is pumped and filtered from a small dam on a stream running from the high terrace into the lowland forest.

As the polishing finishes are being put on the main station, the crew carpenters and builders working under Renan Valega (station/concession operations specialist and manager and expert ornithologist) is initiating the building of remote camps that will provide long-term researchers with the chance for basic accomodations at selected sites throughout the concession. The remote camps will include tent/hammock platforms, a water supply, and waste disposal.

We travel by car from Puerto Maldonado to Laberinto, which takes about 40 minutes in optimal driving conditions. During rains, the road becomes muddy and the travel time increases, sometimes drastically. From Laberinto we travel in one of the Los Amigos boats upriver approximately 5-7 hours, depending on water level and the amount of rubbish floating on the water. After a full day's travel, we usually arrive at the Los Amigos Research Station by about 4-5 p.m. The boat travels about every two days on average.

See Map Gallery for more geographic information.

2.2 Site Description of the Los Amigos Conservation Area[2]

2.2.1 Site Description by Robin Foster

Robin Foster prepared the following essay as a report following preliminary field work at Los Amigos. He also compiled a list of plant species based on his extensive knowledge of the flora of Madre de Dios, Peru, and the Neotropics in general. His essay provides an informative introduction to the Los Amigos River watershed

[1] This content is available online at <http://cnx.org/content/m11586/1.2/>.
[2] This content is available online at <http://cnx.org/content/m11592/1.2/>.

and surrounding area in the southwestern Amazon, based on his knowledge and impressions. The plant list is provided as a searchable database (see Databases).

2.2.2 Some Description of the Rio Los Amigos, Madre de Dios, Peru

Robin B. Foster Environmental & Conservation Programs The Field Museum, Chicago 20 April, 2001

The principal drainage of the Southwestern Amazon Basin is the Madre de Dios/Madeira river system. In Southeastern Peru the Madre de Dios and its extension, Rio Manu, come up to and drain the eastern slopes of the Andes. But they also drain the relatively flat Amazon Plain to the north. One of these northern tributaries is the Rio Los Amigos. Until it joins the big river, the Rio Los Amigos and its branch the Amigillos run roughly parallel to the Rio Madre de Dios. Its mouth is half-way between the junction of the Manu and the junction of the Rio Piedras (another northern tributary, also roughly parallel to the Amigos).

The Rio Los Amigos passes through two very different kinds of Amazon terra firme. From its mouth north to the split of the Amigillos and for 15 km further upstream, the Amigos passes through an area of high terraces, notable for being very flat with only infrequent cutting by small streams. These flat terraces are the very western tip of a formation that forms a broad regional arc of weakly dissected uplands. This formation does not go south of the Rio Madre de Dios except in the vicinity of Puerto Maldonado (where it crosses over to just beyond the Rio Tambopata), but instead sweeps northeast into Pando, Bolivia, eastern Acre, Brazil, and beyond.

The vegetation of these flat terraces has a high (40 m) mostly-closed canopy. It is characterized by a high density of castanas (*Berthlletia excelsa*) and other emergent trees of the same family, Lecythidaceae. These are of course mixed with hundreds of other tree species, but few as prominent. The trees are mostly straight-trunked with relatively small crowns, stranglers are rare, density of lianas is relatively low, and herbs, epiphytes, and trunk climbing plants are few.

For the most part it is a beautiful and easy-to-walk-through forest, and in this western end of the formation is remarkably undisturbed, regardless of the obvious visits by castaneros. Nor does it show any of the signs of having been extensively cleared several hundred years ago, such as are found on the hills and terraces in much of Pando near the Rio Tahumanu. Where this terra firme has been disturbed in the past (other than by downburst windstorms) is along stretches of the bluffs over the Amigos floodplain, presumably by indigenous peoples over hundreds of years. These areas are now thick with bamboo (pacales) in well defined blocks along the bluffs such as northeast of the Centro Rio Amigos station (near where the floodplain of the Amigos meets the floodplain of the Madre de Dios) and at the bifurcation of the Amigillos and Amigos.

The second kind of terra firme is encountered about 40 km straight up the Amigos from its mouth and 60 km following up the Amigillos. Here, sometimes abruptly and sometimes gradually, there is a transition to highly dissected steep hills ~50-100 m high or higher. This is the southernmost end of a large regional physiographic formation, interrupted only by rivers, that stretches northwest and north for hundreds of kilometers in to the Ucayali Department of Peru, western Acre, Brazil, and beyond. It also does not pass south of the Rio Madre de Dios, though it does appear to be on both sides of the Manu floodplain above the Rio Pinquen. All the upper reaches of the Amigos and Amigillos drain from this formation.

The vegetation of the dissected hills occupies the largest area of the Madre de Dios Department and is the least known. Much of it is also not particularly inviting. Large parts of the area are covered with an understory of spiny bamboo (three species of *Guadua*), mostly under a sparse tree canopy but occasionally as open solid stands. Other large parts are covered with dense vine tangles. Yet other parts seem to have closed canopy forest. While perhaps not as attractive as the flat terrace forest, the mystery of the dynamics and history of these different vegetation types is an intriguing, challenging, and important problem.

Why these two physiographic formation? Perhaps the flat terraces are geologically younger. Perhaps the dissected hills are being raised faster from below by the upthrust from the Nazca plate sliding under the continent. Perhaps the composition of these ancient sediments are different, resisting erosion in the flat terraces, succumbing to erosion in the dissected hills.

The third important formation is the Amigos floodplain itself. Although the river is a meandering one, the formation of oxbow lakes (cochas) is either not very common (except near the mouth) or they fill

rapidly. Small stands (aguajales) of swamp palms (*Mauritia flexuosa*) are frequent along the margins of the floodplains. Succession on the meander beaches appears to be similar in composition to that of the Manu and Madre de Dios meanders, though perhaps not as rich in species, but a smaller version with the same process of forest formation.

The easy access to mostly intact versions of the two major terra firme formations of southeastern Peru, the unspoiled floodplains of the Amigos and Amigillos, not to mention the kaliedoscopicarray of barely-studied floodplain habitats and low terraces along the adjacent Rio Madre de Dios and south of it, all argue strongly for this area as an ideal center for both basic research and for research on land and forest management of southeastern Peru in particular and the southwestern Amazon in general.

2.3 Images of the Los Amigos Conservation Area[3]

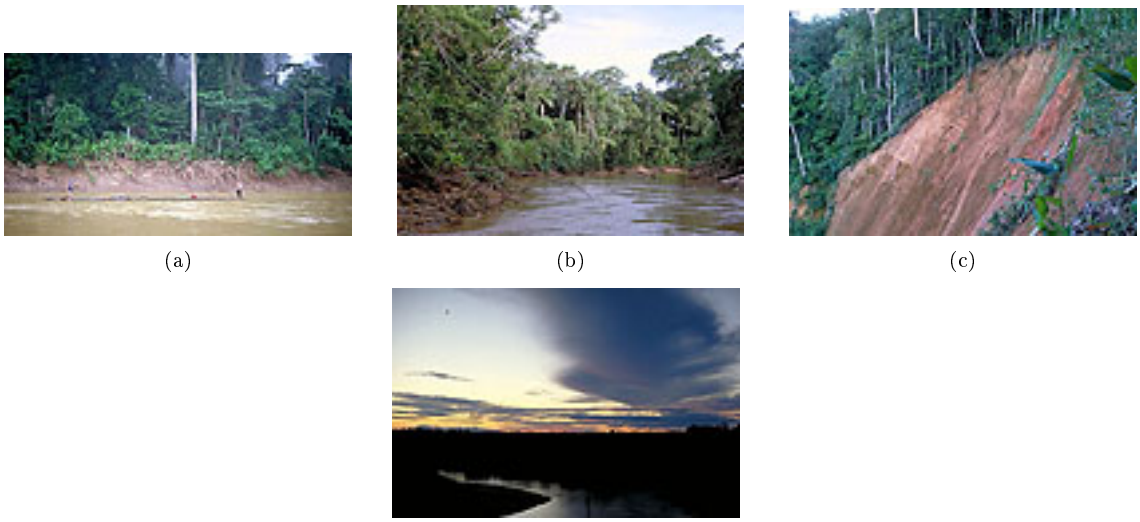
2.3.1 Images

Link to the following images for a glimpse of the Los Amigos Research Station and Conservation Area. Visit the database-driven Image Gallery which now has 1113 images of plants, animals (humans included), and places from the Los Amigos Conservation Area.

(a) (b) (c) (d)

Figure 2.1: (a) Research Station[4] (b) Remote Camp[5] (c) Rio Madre de Dios[6] (d) Rio Madre de Dios[7]

[3] This content is available online at <http://cnx.org/content/m11588/1.6/>.
[4] http://cnx.org/content/m11588/latest/IMG0034.jpg
[5] http://cnx.org/content/m11588/latest/IMG0010.jpg
[6] http://cnx.org/content/m11588/latest/IMG0051.jpg
[7] http://cnx.org/content/m11588/latest/IMG0005.jpg



(a) (b) (c) (d)

Figure 2.2: (a) Rio Los Amigos[8] (b) Rio Los Amigos[9] (c) High Terrace, Rio Amigos[10] (d) Rio Madre de Dios[11]

2.4 Satellite Images

2.4.1 Los Amigos Conservation Area and Research Station - Map 1[12]

2.4.1.1 Map 1

Location of the Los Amigos River watershed, upriver from Puerto Maldonado, in Madre de Dios, Peru.

[8] http://cnx.org/content/m11588/latest/IMG0031.jpg
[9] http://cnx.org/content/m11588/latest/IMG0006.jpg
[10] http://cnx.org/content/m11588/latest/IMG0041.jpg
[11] http://cnx.org/content/m11588/latest/IMG0047.jpg
[12] This content is available online at <http://cnx.org/content/m11589/1.2/>.

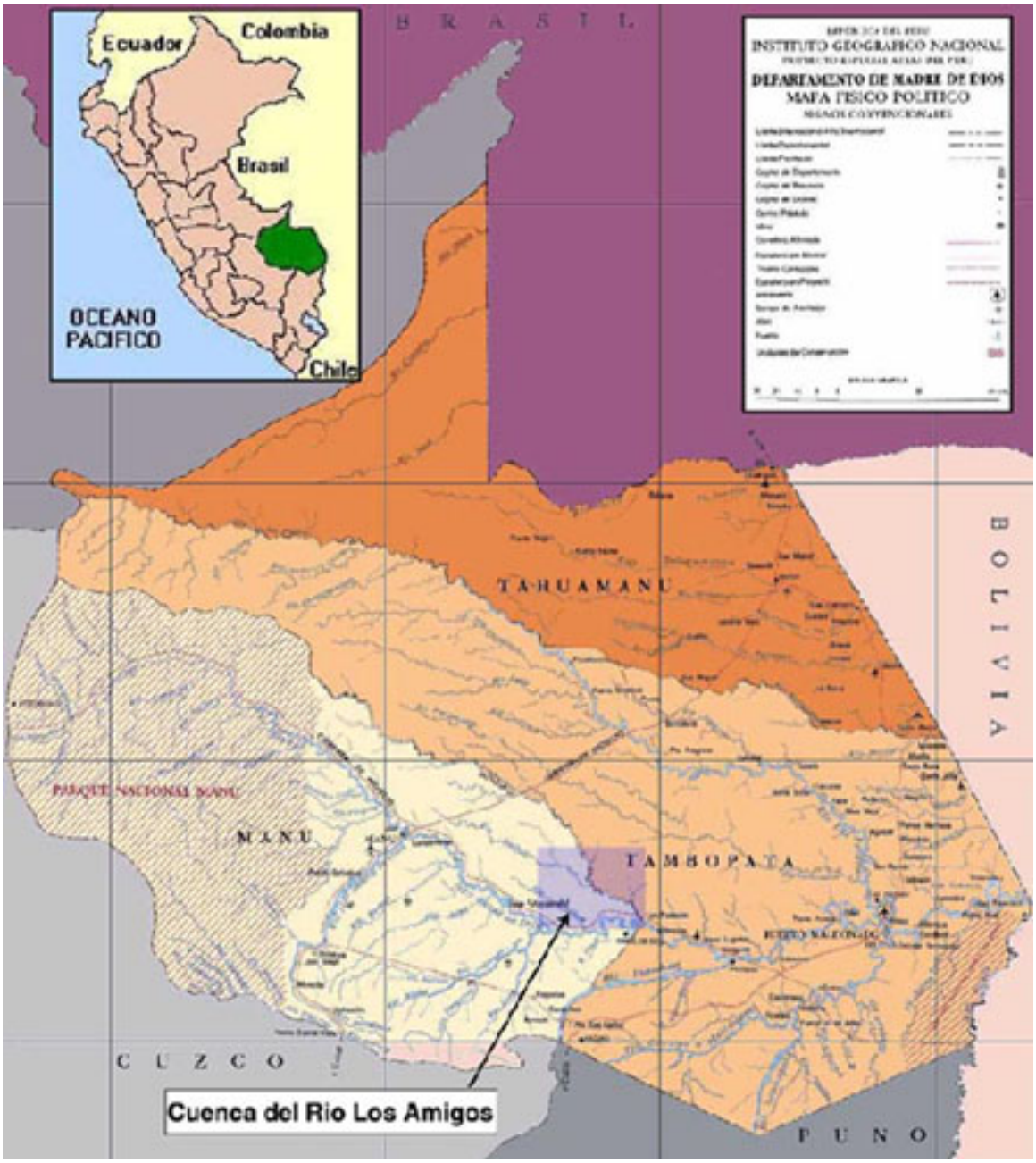

Ecuador
Colombia
Brasil
OCEANO PACIFICO
Chile
BRASIL
INSTITUTO GEOGRAFICO NACIONAL
DEPARTAMENTO DE MADRE DE DIOS
MAPA FISICO POLITICO
TAHUAMANU
BOLIVIA
PARQUE NACIONAL MANU
MANU
TAMBOPATA
CUZCO
PUNO
Cuenca del Rio Los Amigos

Figure 2.3

2.4.2 Los Amigos Conservation Area and Research Station - Map 2[13]

2.4.2.1 Map 2

Landsat Image 1996, showing the Madre de Dios and Los Amigos Rivers. The station sits on a high terrace with a west-facing view across lowland forest towards the Andes Mountains in the distance. (West on this map is to the bottom left)

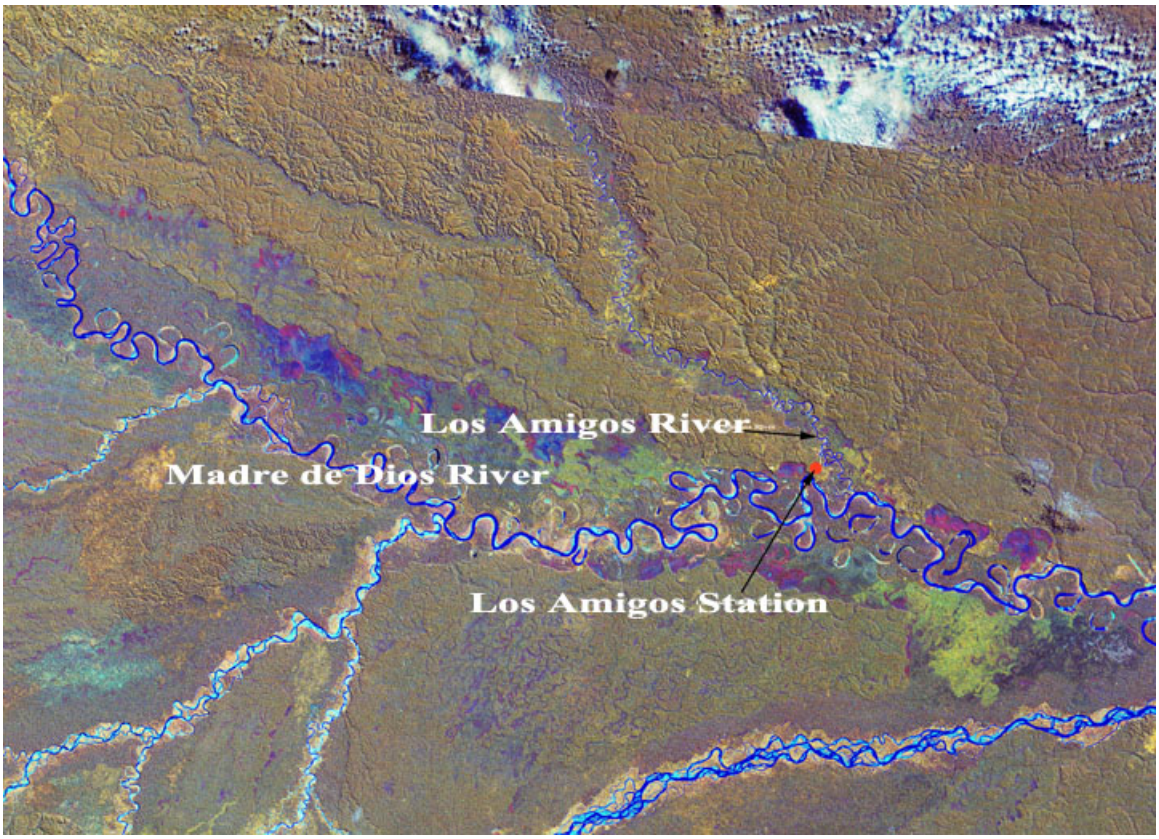


Figure 2.4

2.4.3 Los Amigos Conservation Area and Research Station - Map 3[14]

2.4.3.1 Map 3

Closer view of the location of the Los Amigos Research Station, sitting on a high bluff over the Madre de Dios River. Note the large purple spot to the left of the red location point. This is a huge Mauritia (Aguaje, Arecaceae) palm swamp that is being monitored for plant and animal diversity, and we are also beginning a study to valuate the economic potential of the Mauritia swamps in the Los Amigos Conservation Area.

[13] This content is available online at <http://cnx.org/content/m11590/1.2/>.
[14] This content is available online at <http://cnx.org/content/m11591/1.2/>.

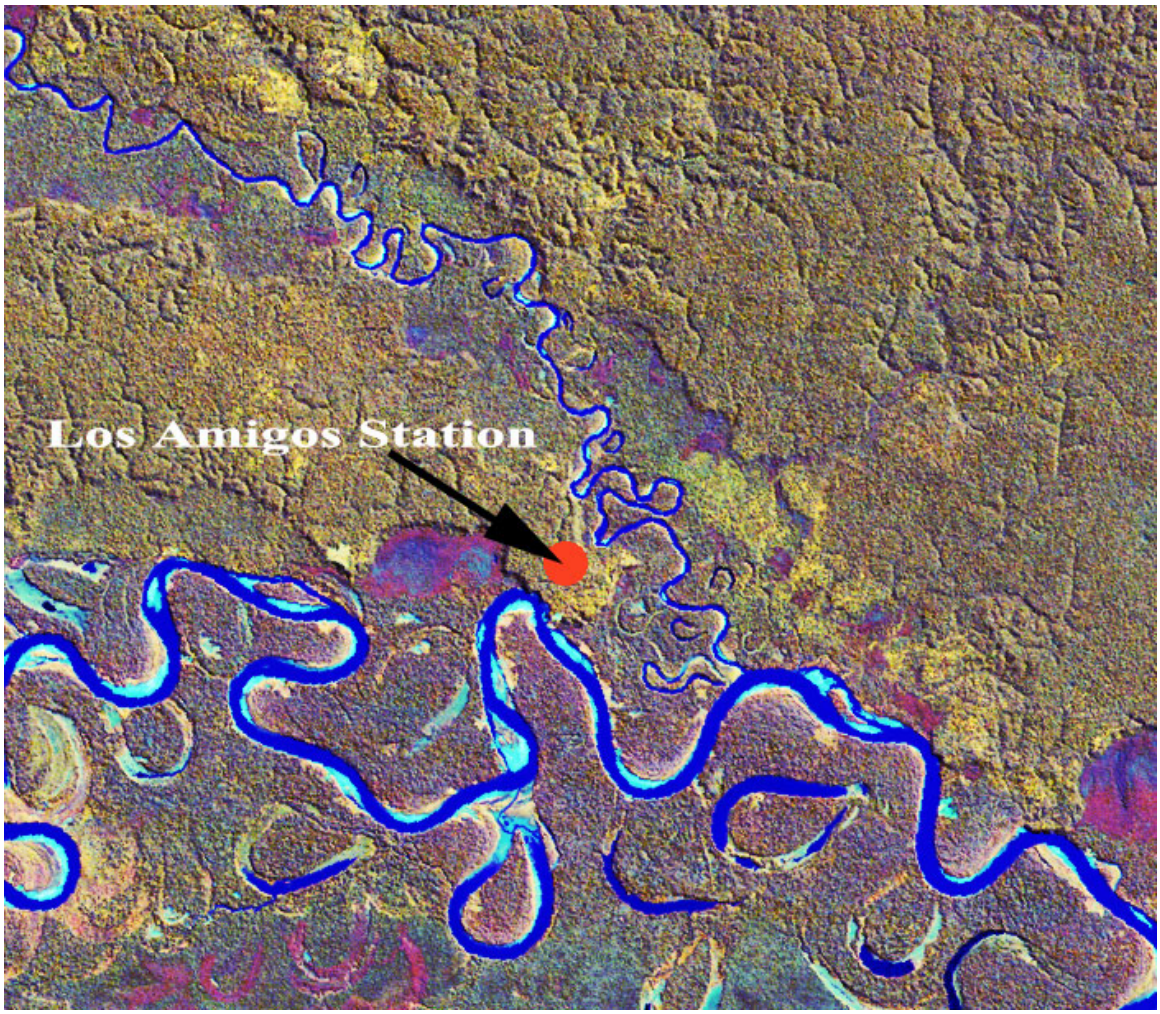


Figure 2.5

Chapter 3

Interactive Databases

3.1 Los Amigos Plant Collection Database[1]

3.1.1 Description of the Los Amigos Plant Collection Database 2001-2003

New! Search the Los Amigos Plant Collections Database (August 2003)!

Figure 3.1: Cochlospermaceae, Cochlospermum orinocoensis, Janovec 2715.

The Los Amigos Botany Databases have grown rapidly based on all collections that have been made in the Los Amigos area during 2001-2003. Collectors include John Janovec, Fernando Cornejo, Piers Majestyk, Piher Maceda, and Pedro Centeno. Robin Foster and Hamilton Beltrán conducted preliminary studies at Los Amigos early in 2001. Their plant lists are maintained here in searchable format.

[1] This content is available online at <http://cnx.org/content/m11599/1.2/>.

The Los Amigos Plant Collections Database is now available for searching, with approximately **2700 collection records**, including vascular plants, bryophytes, and lichens. We are in the process of adding many new collection records and integrating about **4000 images** from the Los Amigos Botany Project with specimen searches. Databases are operated using a combination between Filemaker Pro, MS Access, and MSSQL. Updates are made on a regular basis.

We have entered into Phase II of the Los Amigos Botany Project, which involves continued exploration of the Los Amigos Conservation Area, a 400,00 acre (140,000 hectare) wildland protected by a private conservation concession and management plan. Phase II also involves the development a database of information about taxa of the Los Amigos flora. This includes general information and descriptive characteristics for the >1000 species we have collected mostly from about 500 hectares of forest around the Los Amigos Biological Station. These >1000 species represent about 130 families and 475 genera of plants. A database is being developed to handle character information and other information about families, genera, and species of the Los Amigos flora.

We are also working with Dr. Bryan Heidorn of the University of Illinois Urbana-Champaign School of Library and Information Science to develop a web-based Los Amigos Botanical Information System that will provide new innovative search engine techniques and a collaborative working environment for continued documentation of plant diversity of Los Amigos, Madre de Dios, Peru, and the Andes-Amazon region of SE Peru in general.

3.1.2 Feedback

We will appreciate any comments, corrections, preliminary determinations we can get. This website is becoming part of the communication system between taxonomic experts and the Los Amigos Botany Project as we develop plant guides to the Los Amigos Biological Station and Conservation Area.

Please search through your favorite families and view the images we have available. If you can help with preliminary names, name corrections, we will appreciate and acknowledge your input. And if you need herbarium specimens, images, or special collections of particular plants for morphological, anatomical, or molecular research, please contact us about cooperation and collaboration. Please e-mail John Janovec at jjanovec@brit.org.

Chapter 4

Photo Essays

4.1 Introduction to Photographic Essays[1]

4.1.1 Introduction

The available photographic essays provide image-rich summaries of selected topics related to Botany of the Los Amigos Conservation Area. An overall goal for the Botany project is to discover and document the botanical diversity of the study area. Through the available photographic essays, you can view the people and places of the Botany project during 2001-2002 – plant collectors, field assistants, students, and principal investigators.

The first available photographic essay is contributed by Amanda Neill about **Gurania**, a large genus of the cucumber family of flowering plants. Amanda is a Ph.D. student conducting taxonomic, evolutionary, and biogeographic studies of Gurania at The New York Botanical Garden. The Los Amigos Biological Station and Conservation Area have provided Amanda with a golden opportunity to conduct intensive long-term studies of the morphology, biology, and ecology of five sympatric species of **Gurania**.

Mauritia flexuosa(Arecaceae) is a majestic palm growing to 25 meters in dense mono-dominant stands formed in swamps (called "Aguajales") in the Madre de Dios River valley and other regions of the Peruvian and Brazilian Amazon. This large palm, often called the "tree of life" in the Iquitos, Peru, region, is well-known as a wild-harvested source of edible fruits, fruit secondary products (i.e., ice cream), and fibers. The Aguajal Project has been initiated through a collaboration between John Janovec and Mathias Tobler. Preliminary studies of the Aguajal ecosystem in and around Los Amigos in the Madre de Dios have uncovered new data on the biology, ecology, fruit production, and economic value of Mauritia flexuosa in the Los Amigos area. These findings are being written in manuscript format for submission to a peer-reviewed scientific journal (Biodiversity and Conservation). The purpose of the Aguajal Project photographic essay is to introduce you, through vivid and diverse imagery, to a summary of our findings, hypotheses, needs, and concerns about the Aguajal palm swamps of the Los Amigos area.

During July-August 2002, Piers Majestyk accompanied John Janovec to Los Amigos where he spent several weeks making collections of the cryptogams of Los Amigos. See the Cryptogamic Flora of Los Amigos essay, which currently focuses on summarizing a young project aimed at discovery and documentation of the mosses, lichens, liverworts, and ferns of the area. Please be patient as identifications are made.

One major highlight of the 2001-2002 Botany activities at Los Amigos has been the new collaboration involving Mathias Tobler who comes to us from Switzerland. Mathias was trained in GIS and Landscape Ecology through a M.S. program at the Swiss Institute of Technology. He has considerable experience in tropical field research, as he has conducted savannah ecology studies in Tanzania and Tapir studies in Costa Rica. Through his previous academic and independent projects, Mathias has become an expert at GIS mapping, remote sensing, mammal monitoring, and integrative techniques of landscape ecology. Here we use

[1]This content is available online at <http://cnx.org/content/m11574/1.1/>.

an image-rich essay format to present some of the geospatial characteristics of the landscape of Los Amigos and vicinity. This also relates to the Aguajal Project.

Dan Lebbins, a Ph.D. student in the Ornithology Laboratory at Cornell University, visited the Los Amigos Biological Station and Conservation Area for a period of four days in late July. His diligence and skills allowed him to quickly assess the bird diversity and community structure at Los Amigos and begin building a list of bird species that occur in the area. Because of Dan's skill and passion for tropical bird studies, Mathias and John have added him to a team that plans to ask specific questions about the distribution, species diversity, ecology, economics, conservation, and management of the Aguajal ecosystem.

4.2 Jungle Cucumbers

4.2.1 Los Amigos Jungle Cucumbers: A Study of Five Sympatric Gurania Species[2]

4.2.1.1 Introduction

Table 4.1

The Cucurbitaceae is a family of herbaceous and woody vines concentrated in tropical regions of the world, and much appreciated for their edible and useful fruits (cucumbers, squashes, melons, and gourds). While the economically important members of the Cucurbitaceae have received much attention by botanists, those wild genera not historically domesticated by humans are also worthy of study.

Gurania (also known as the "Jungle Cucumber") is one of the largest genera in the Cucurbitaceae, with an estimated 40-75 species growing throughout the New World tropics. **Gurania** flowers are showy, with an orange to red calyx (sepals)– a character not found elsewhere in the Cucurbitaceae. The petals are tiny, yellow, and mostly hidden by the large sepals, which attract the hummingbirds and **Heliconius** butterflies that pollinate the flowers. **Gurania** plants are monoecious, meaning that flowers are only of one sex, but both male and female flowers can be produced on a single plant. However, they are not both produced on one plant at the same time, so plant-to-plant movement by pollinators is neccessary for fertilization. The green, pickle-sized fruits of **Gurania** are known to be dispersed by bats in the genus **Phyllostomus**, and are probably eaten by several bird species as well.

Current experts in the Cucurbitaceae, not to mention non-specialists, find **Gurania** species notoriously difficult to identify with certainty. But these showy and ecologically important plants are found in nearly all moist lowland and montane forests in the Neotropics, and researchers conducting floristic and ecological studies in these regions need to identify the plant species they encounter. No single publication contains keys and descriptions for all the species of Gurania. Such a publication, known as a monograph, is the goal of my doctoral research at the New York Botanical Garden.

[2]This content is available online at <http://cnx.org/content/m11600/1.1/>.

During two months of field research on **Gurania** at the Los Amigos Biological Station in Madre de Dios, Peru, I was fortunate to be able to find and study five species of Gurania, growing and reproducing sympatrically (in one area and simultaneously). Previously, only two common Gurania species had been identified in the Los Amigos Conservation Area. Three more species of restricted habitats were discovered at the station in the course of my study.

With the assistance of the staff of the Amazon Conservation Association (ACA) and the Asociación para la Conservación de la Cuenca Amazónica (ACCA) at Los Amigos Station, and with laboratory equipment available at the station's botanical laboratory, I have come to know these five **Gurania** species intimately. Through weeks of pollination activity observation, habitat investigation, macro- and micro-photography, and collection of preserved plant samples for herbarium study, I have accumulated a great deal of data. This work has also given me a greater understanding of the characteristics that both demonstrate directional selection (driving the evolution and divergence of species) and define the differences between species (allowing me to create useful keys and descriptions so that non-specialists can identify these plants). This was an excellent place to gain experience with Gurania that I can put to use in the herbarium and in future fieldwork at other sites. This ongoing study was conducted in collaboration with the Botany of the Los Amigos Conservation Area[3] project.

4.2.2 Jungle Cucumbers Images

4.2.2.1 Los Amigos Jungle Cucumbers - Figure 1[4]

Figure 4.1

[3] http://botanypages.org/Janovec/losamigos/default.htm
[4] This content is available online at <http://cnx.org/content/m11575/1.2/>.

Gurania is a beutiful and complex genus of 40-75 species of Neotropical vines. It is surprising that *Gurania* is only rarely seen in public works of art, such as this stamp from Costa Rica.

4.2.2.2 Los Amigos Jungle Cucumbers - Figure 2[5]

(a) (b)

Figure 4.2

Gurania plants are herbaceous and woody vines that climb into the forest canopy with tendrils. The herbaceous plants are sometimes found in disturbed and sunny habitats. The species that produce large woody vines have their greatest success in undisturbed primary forests– in fact, mature vines (those that are large enough to produce female flowers and therefore fruits) can only survive without disturbance of the large trees that support them.

[5]This content is available online at <http://cnx.org/content/m11576/1.2/>.

4.2.2.3 Los Amigos Jungle Cucumbers - Figure 3[6]

(a) (b)

Figure 4.3

The calyx tube and sepals are brightly-colored (orange to red) and the petals are smaller and yellow. *Gurania* flowers have separate sexes. Male flowers have two anthers attached to the inner wall of the calyx tube. These anthers have just released their pollen, the grains of which are large enough to be seen with the naked eye.

[6] This content is available online at <http://cnx.org/content/m11577/1.2/>.

4.2.2.4 Los Amigos Jungle Cucumbers - Figure 4[7]

(a) (b)

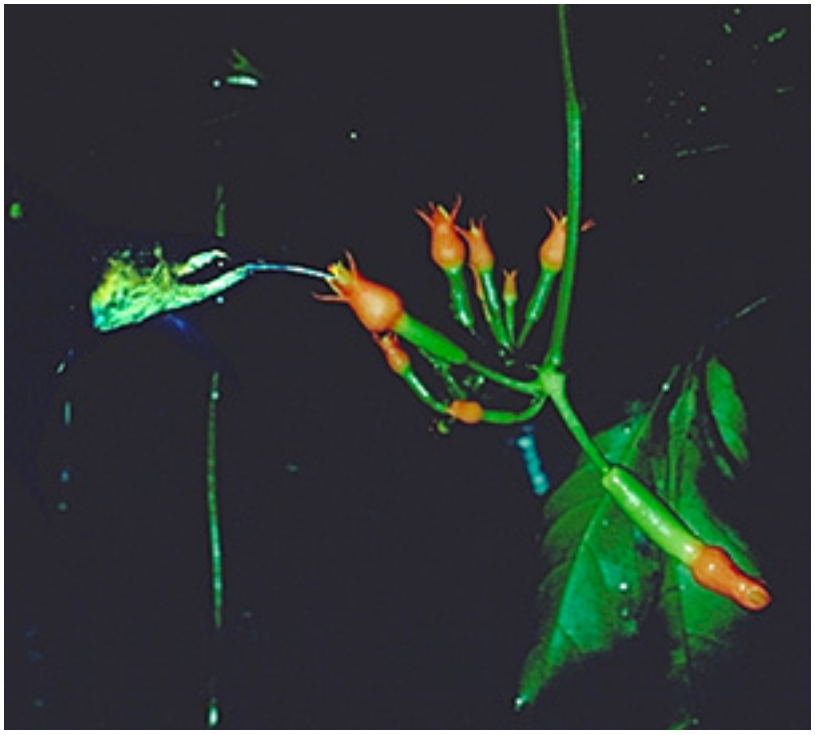
Figure 4.4

The ovaries of the female *Gurania* flowers are inferior, that is, they develop beneath the flower rather than inside of it. On the right is an immature fruit, cut in half longitudinally. You can see the resemblance to a cucumber. Some ants (seen on the central flower) like the taste of *Gurania* nectar.

[7] This content is available online at <http://cnx.org/content/m11578/1.2/>.

4.2.2.5 Los Amigos Jungle Cucumbers - Figure 5[8]

(a)



(b)

Gurania is an exciting genus to study, because many interesting animals rely upon these plants for food. The flowers are pollinated by hummingbirds and *Heliconius* butterflies. Hummingbirds seek out the sweet nectar while butterflies are interested in the nutritious pollen. The fruits are eaten by bats, and this is how the seeds are dispersed.

4.2.2.6 Los Amigos Jungle Cucumbers - Figure 6[9]

Figure 4.6

The Los Amigos Biological Station sits on a high bluff between the Madre de Dios and Los Amigos rivers. The land around the station includes secondary disturbed forest, *Mauritia* palm swamp, frequently-inundated lowland forest, creek-dissected slope forest, and upland plateau primary forest. The five *Gurania* species in the Los Amigos area are found in several differing habitats.

[9] This content is available online at <http://cnx.org/content/m11580/1.2/>.

4.2.2.7 Los Amigos Jungle Cucumbers - Figure 7[10]

Figure 4.7

Plants that thrive in naturally disturbed areas, like openings created by falling trees, also enjoy the extra light and space created by man-made clearings, like this airstrip. The two *Gurania* species at Los Amigos that are most frequently encountered are *G. spinulosa* and *G. ulei.* Perhaps they are most easily seen because they occur in the airstrip and along trails, in light gaps. The *Cecropia* trees and other shrubs on the border of the airstrip you see here are coated with the draping vines of these two *Gurania* species, growing together.

[10]This content is available online at <http://cnx.org/content/m11581/1.2/>.

4.2.2.8 Los Amigos Jungle Cucumbers - Figure 8[11]

(a)

Gurania ulei presents shiny bright-orange flowers with wide-open, star-like sepals. On the right is a male inflorescence, and in the center is a female inflorescence. Both kinds of inflorescences usually only have one or two flowers open per day (to keep the pollinators coming back regularly). The mature fruits are blue-green with creamy speckles and a waxy bloom. The plants are mostly hairless and the stems never seem to get very large in diameter or woody. This species seems to be primarily pollinated by butterflies.

4.2.2.9 Los Amigos Jungle Cucumbers - Figure 9[12]

(a)

(b)

(c)

Gurania spinulosa is a common species, widespread throughout South America, and weedy in its habits. The flowers are paler orange, with green-yellow sepal tips, and a narrower opening of the sepals in general. The fruits are wide, yellow-green-streaky, and shiny. The leaves are large, with up to seven lobes, and covered with short rough hairs, as are the thick stems. This species is also pollinated primarily by butterflies.

4.2.2.10 Los Amigos Jungle Cucumbers - Figure 10[13]

(a)

(b)

(c)

Figure 4.10

In undisturbed upland forest, amongst the largest old trees, *Gurania insolita* enjoys dry soils and shade. These plants climb high into the treetop canopy, and along the way they produce male inflorescences on short peduncles (stalks) that dangle downward. Hummingbirds and butterflies have both been seen at these flowers, which are hairy, just like the four-sided stems that produced them.

4.2.2.11 Los Amigos Jungle Cucumbers - Figure 11[14]

4.2.2.11.1 Los Amigos Jungle Cucumbers: A Study of Five Sympatric Gurania Species

Amanda K. Neill
The New York Botanical Garden

Table 4.2

Figure 11
Female inflorescences of *Gurania insolita* take different forms, depending on the age of the stem that produced them. Old leafless woody stems produce cauliflorous inflorescences, with tightly-packed flowers, on a short peduncle. The photo on the right shows a longer, more flexible inflorescence that was produced by a young leafy stem. These inflorescences have leafy bracts with a red tint. The fruits in this species have bold white stripes and spots.
Previous | Next
Photos by John Janovec

4.2.2.12 Los Amigos Jungle Cucumbers - Figure 12[15]

4.2.2.12.1 Los Amigos Jungle Cucumbers: A Study of Five Sympatric Gurania Species

Amanda K. Neill
The New York Botanical Garden

[14] This content is available online at <http://cnx.org/content/m11594/1.2/>.
[15] This content is available online at <http://cnx.org/content/m11595/1.2/>.

Table 4.3

Figure 12

Gurania bignoniacea prefers to grow in soggy ravines, thriving even with its roots growing in the mud under flowing streams. This species is the only one of the five at Los Amigos that has compound (trifoliolate) leaves. Both the leaves and stems are slightly hairy, and the inflorescences and flowers are tiny compared to the other species at the station.

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Photos by Mathias Tobler and Amanda Neill

4.2.2.13 Los Amigos Jungle Cucumbers - Figure 13[16]

4.2.2.13.1 Los Amigos Jungle Cucumbers: A Study of Five Sympatric Gurania Species

Amanda K. Neill

[16] This content is available online at <http://cnx.org/content/m11596/1.2/>.

The New York Botanical Garden

Table 4.4

Figure 13

The tiny flowers of *Gurania bignoniacea* are unusual in that the sepals are actually shorter than the petals. In overall aspect, the flowers and fruits look a lot like those of *Gurania ulei*, because these two are closely-related species. Butterflies find these flowers irresistable.

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Photos by John Janovec

4.2.2.14 Los Amigos Jungle Cucumbers - Figure 14[17]

4.2.2.14.1 Los Amigos Jungle Cucumbers: A Study of Five Sympatric Gurania Species

Amanda K. Neill

The New York Botanical Garden

[17] This content is available online at <http://cnx.org/content/m11597/1.2/>.

Table 4.5

Figure 14

The rarest *Gurania* species at Los Amigos seems to be *G. speciosa*, which inhabits lowland forest that is seasonally flooded. This species has hairy, pendulous inflorescences, like those of *G. insolita*, but the plants overall are much more pubescent (silky hairs nearly obscure young shoots), and these stems are round, not square. Hummingbirds seem to be the exclusive pollinators. I have not yet found female flowers or fruits of this species.

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Photos by Mathias Tobler (left) and John Janovec

4.2.2.15 Los Amigos Jungle Cucumbers - Figure 15[18]

4.2.2.15.1 Los Amigos Jungle Cucumbers: A Study of Five Sympatric Gurania Species

Amanda K. Neill

The New York Botanical Garden

[18]This content is available online at <http://cnx.org/content/m11598/1.2/>.

Table 4.6

Figure 15

Many thanks to all those who have helped me find plants and collect data at Los Amigos– employees of ACCA and ACA, such as Pedro Centeno (shown here with me and *Gurania insolita*), Piher Maceda, Pedro Maceda, and especially John Janovec. Thanks also to the entire support staff at the Los Amigos Biological Station, and at the ACCA office in Puerto Maldonado and the ACA office in Washington, D.C. Read more about people of Los Amigos Botany here. For more information about the author, see www.nybg.org/bsci/grad/aneill . For more photos of Gurania, see The Gurania Pages.

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Photo by John Janovec

4.3 GIS

4.3.1 The Los Amigos Geographical Information System (GIS)[19]

4.3.1.1 The Los Amigos Geographic Information System (GIS)

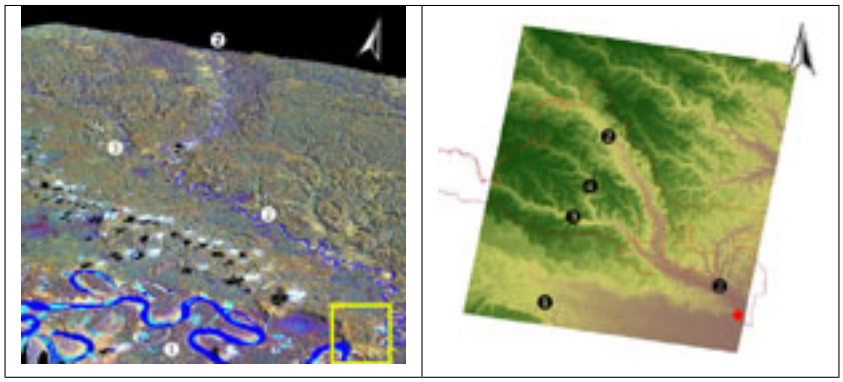

Table 4.7

Mathias Tobler Dept. of Wildlife & Fisheries Sciences TAMU Spatial Science Laboratory Texas A&M University & John Janovec Botanical Research Institute of Texas Amazon Conservation Association

4.3.1.2 Overview

Since August 2002, we have been actively working toward a Geographic Information System (GIS) for the Los Amigos Conservation Area. Our objectives have been to:

- collect and organize available geographic data
- to show possible use of the system in education, training and research; and
- present research results through print and digital means of publication.

A geographic metadatabase has been compiled from various sources, including important files for the Los Amigos Conservation Area provided by colleagues at the Amazon Conservation Association, and files for Madre de Dios, Peru, and the American tropics that have been opportunistically collected during the last year. We continue to gather and input general basemaps, satellite images, climatic data, human population data, and more. In October 2002 we added 15-meter resolution Aster imagery and the first author used them to generate a Digital Elevation Model of the Los Amigos Conservation Area (see DEM imagery at left). A 2000 Landsat TM image was then overlaid on the digital elevation model to create a 3D view of the area (see images at left). We also just received our first IKONOS image from Satellite Imaging Inc. (www.spaceimaging.com), which we will use to produce a high-resolution vegetation map of the area.

Due to the scale of data available for the region, the Los Amigos GIS has quickly expanded to encompass the entire geopolitical region of the Department of Madre de Dios, Peru, and vicinity. This GIS system is currently being used to support studies of the biodiversity in the Los Amigos Conservation Area, but will soon be used for a broadened analysis of the diversity, distribution, collection patterns, and conservation of the plant diversity of Madre de Dios.

Currently, all GIS to Internet presentation is driven by the software HTML Image Mapper offered by Alta 4 (www.alta4.com). Plans for the immediate future are to convert the entire interactive system over to ArcIMS, an internet map server technology by ESRI, while we will continue to use Alta 4 for smaller scale presentations of specific geospatial patterns.

See the Los Amigos GIS Photographic Essay.

Last updated: October 2002. Contact John Janovec at jjanovec@nybg.org.

[19] This content is available online at <http://cnx.org/content/m11593/1.2/>.

4.3.2 GIS Images

4.3.2.1 The Los Amigos Conservation Area[20]

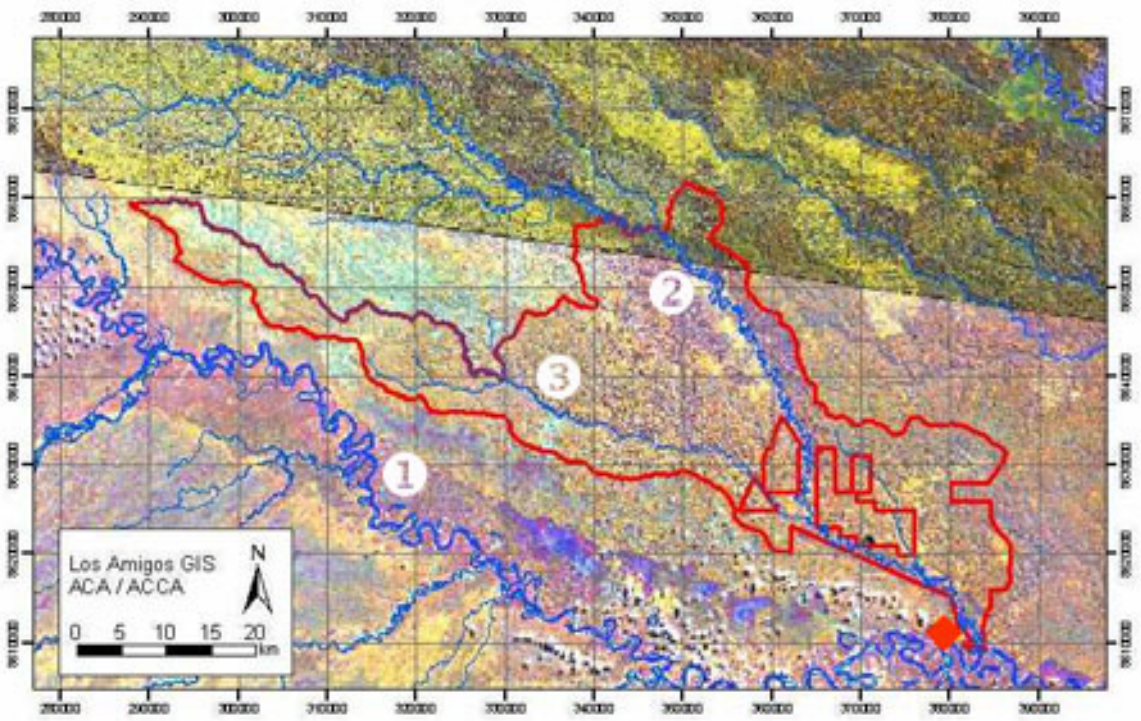

Figure 4.11: The Los Amigos Conservation Area is the first private conservation concession in the world. The long-term mission is aimed at inventory/monitoring, sustainable use/management, and public access/training/education. This map output from Los Amigos GIS shows the conservation area (red line), Madre de Dios River (1), Los Amigos River (2), and the Amiguillos River (3). Situated near the mouth of the Los Amigos River is the Los Amigos Biological Station (red diamond).

[20] This content is available online at <http://cnx.org/content/m11554/1.1/>.

4.3.2.2 Landsat View I[21]

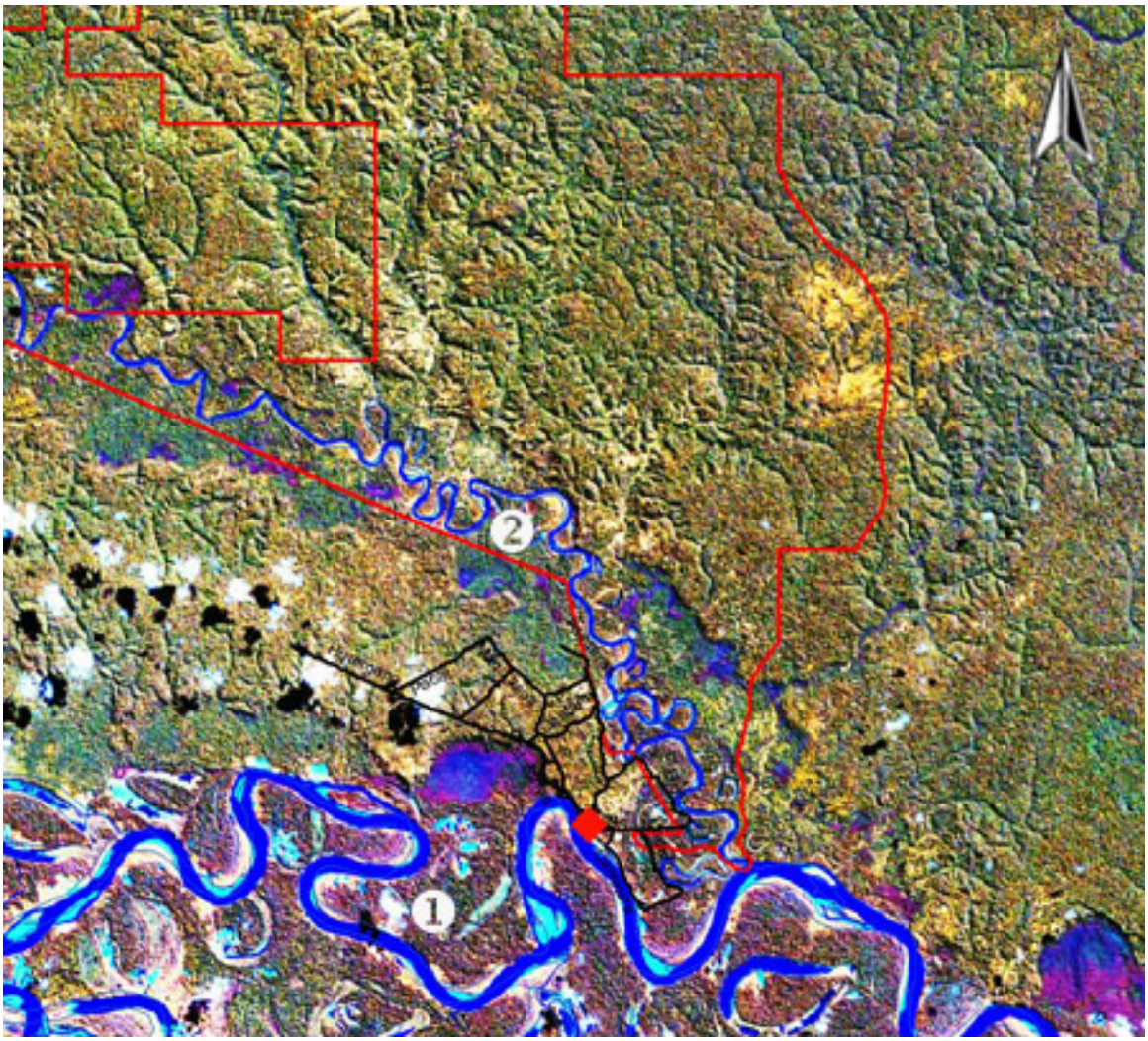

Figure 4.12: Landsat TM satellite image, 2000, showing overlay of the conservation area (red line), trail-map system (black lines), and the location of the Los Amigos Biological Station (red diamond). This scene provides a view of the vast floodplain and meandering complexity of the Madre de Dios River (1) and the smaller Los Amigos River (2)

[21] This content is available online at <http://cnx.org/content/m11555/1.1/>.

4.3.2.3 Landsat View II[22]

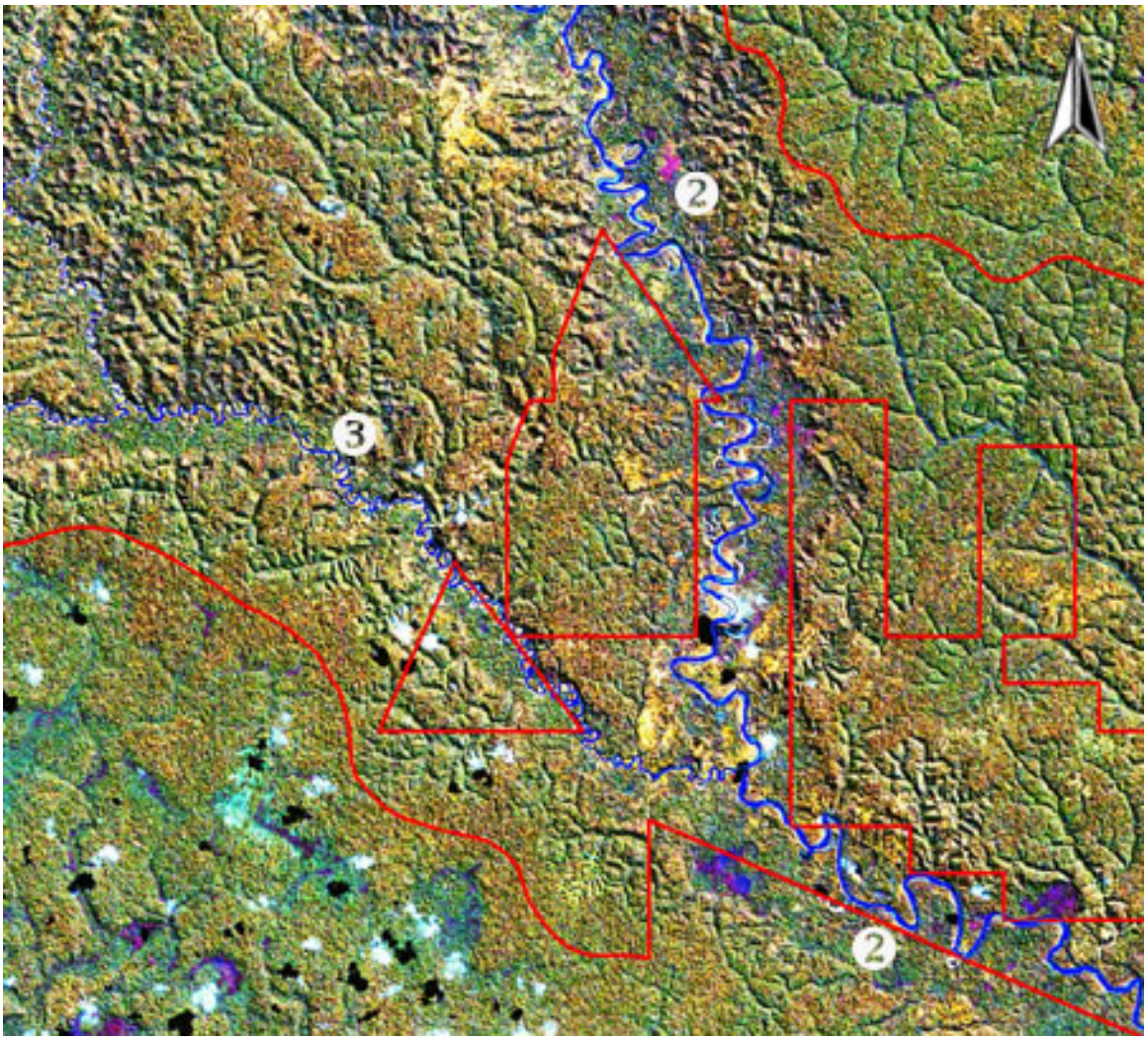

Figure 4.13: This scene shows a region of the upper Los Amigos River (2) and one of its tributaries, the Amiguillos River (3). Notice the dissected terrain depicted in this scene, much different from the lowland floodplain of the Madre de Dios River towards the bottom left of the scene. The Los Amigos and Amiguillos rivers are the primary watersheds protected within concession boundaries (red line).

[22] This content is available online at <http://cnx.org/content/m11556/1.1/>.

4.3.2.4 Property and Trail Maps[23]

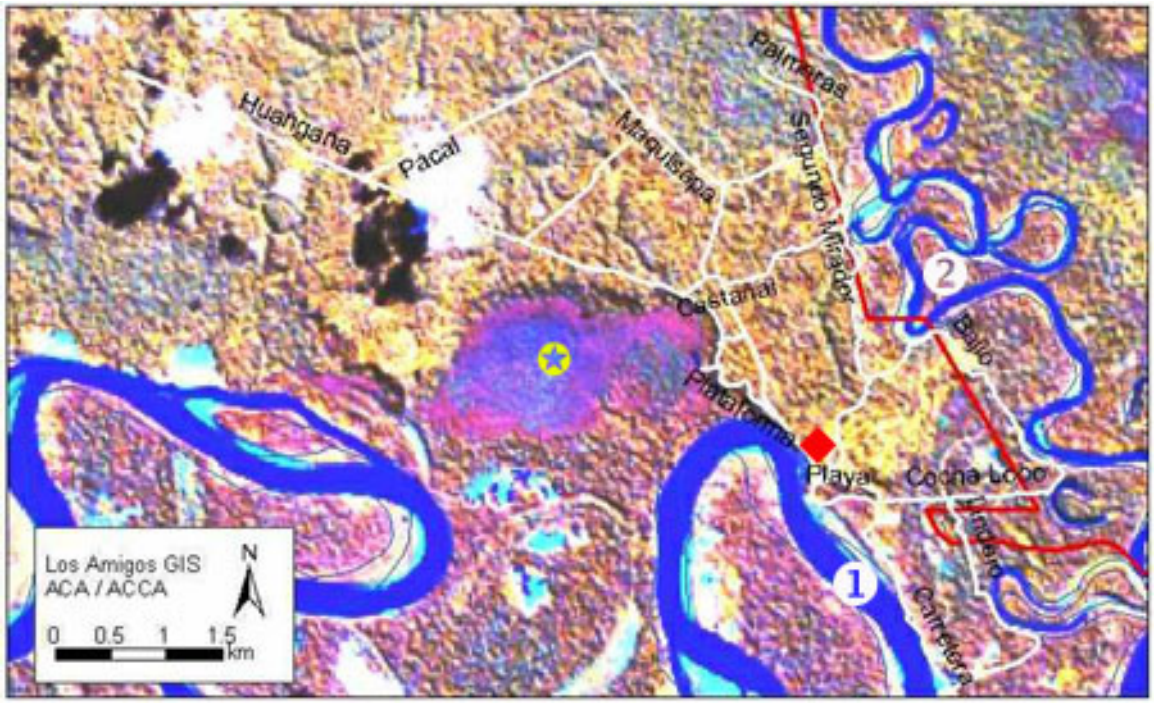

Figure 4.14: During July-September 2002, the Los Amigos Botany Project initiated a collaboration with Mathias Tobler, who is now working at the American Museum of Natural History GIS laboratory in New York City. This collaboration will serve various purposes while working towards several interrelated, interdisciplinary research aims, some of which are provided in the following figures. This scene shows one of the products of the new collaborative research program: a georefenced trail map system of the Los Amigos Biological Station and adjacent property (white lines). Notice the large purple-blue zone (yellow star) in the center of the satellite image; it is a wetland ecosystem characterized by a transition between mixed flooded forest and a mono-dominant stand of the Aguaje Palm (Mauritia flexuosa- Arecaceae). Aguaje Palm swamps, also known as "aguajales", are a dominant factor in the landscape of the Peruvian Amazon, including the Madre de Dios basin.

[23] This content is available online at <http://cnx.org/content/m11557/1.2/>.

4.3.2.5 Georeferenced Trail Map[24]

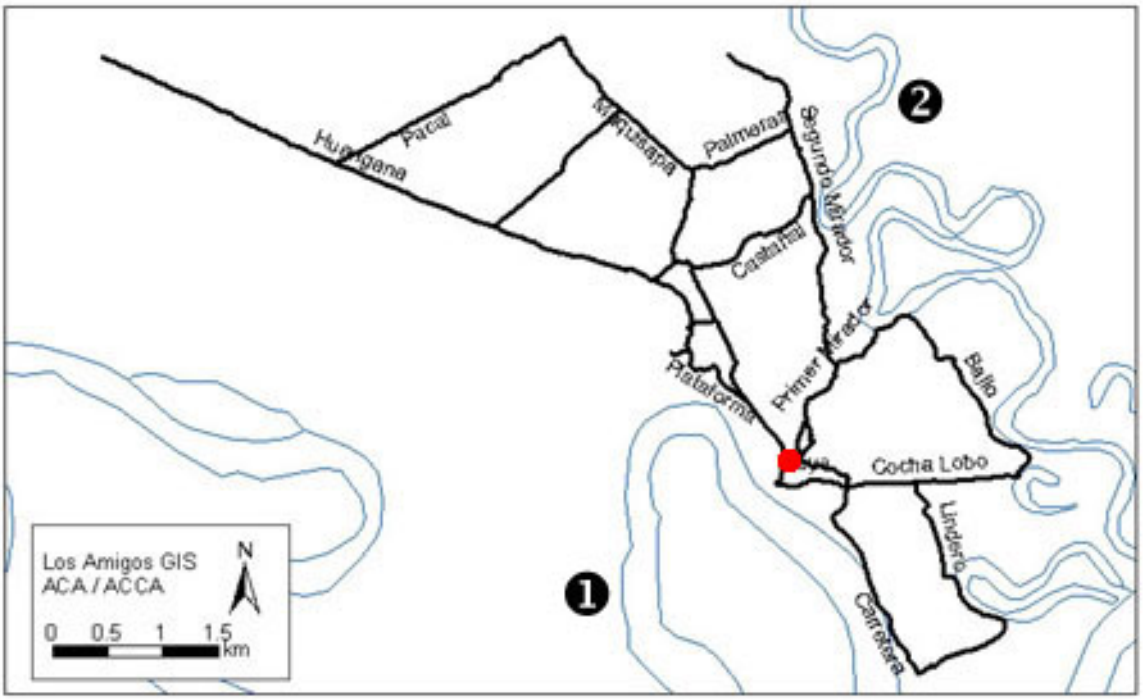

Figure 4.15: This figure shows the location of the biological station (red circle), the trail system (black lines), and the Madre de Dios (1), and Los Amigos (2) rivers. The trails to the right of the station mostly give access to the floodplain forest, called 'terraza baja' or 'bajio'. The trails to the left and above the station traverse through a mixture of vegetation types and the dissected terrain created by multiple streams in the area.

[24] This content is available online at <http://cnx.org/content/m11558/1.1/>.

4.3.2.6 Digital Elevation Model[25]

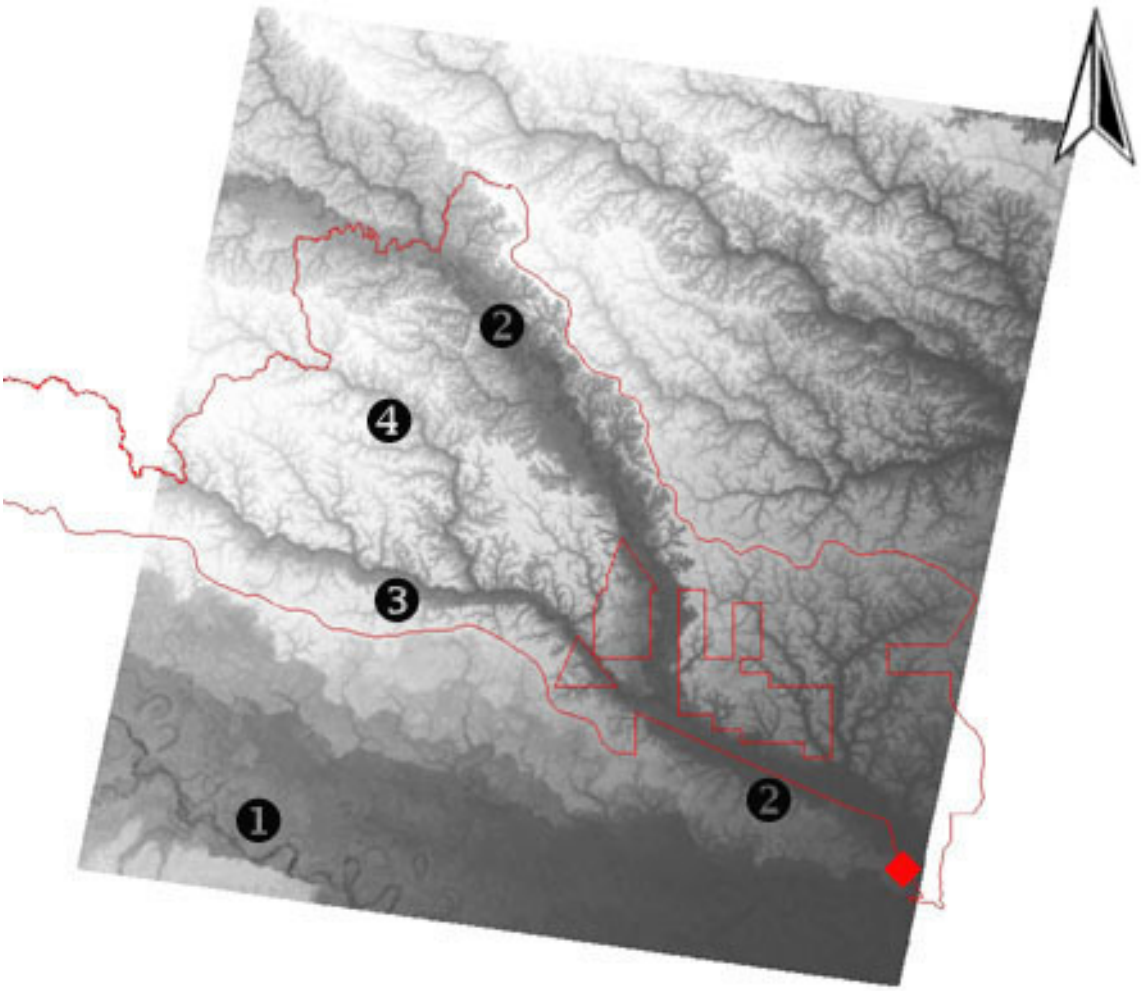

Figure 4.16: The most recent and exciting addition to the Los Amigos GIS is shown above in raw format. Mathias Tobler masterminded the conversion of Aster optic imagery to digital elevation model format. We now have a Digital Elevation Model (DEM) for most of the conservation area (red lines). We plan to use the DEM and products displayed in the rest of this photo essay for two primary purposes: (1) to guide Los Amigos Botany and other projects in exploration and monitoring of the conservation area, and (2) to intensively explore the methods of geospatial and information science, using our landscape-scale investigation as a working model.

[25] This content is available online at <http://cnx.org/content/m11559/1.1/>.

4.3.2.7 Digital Elevation Model[26]

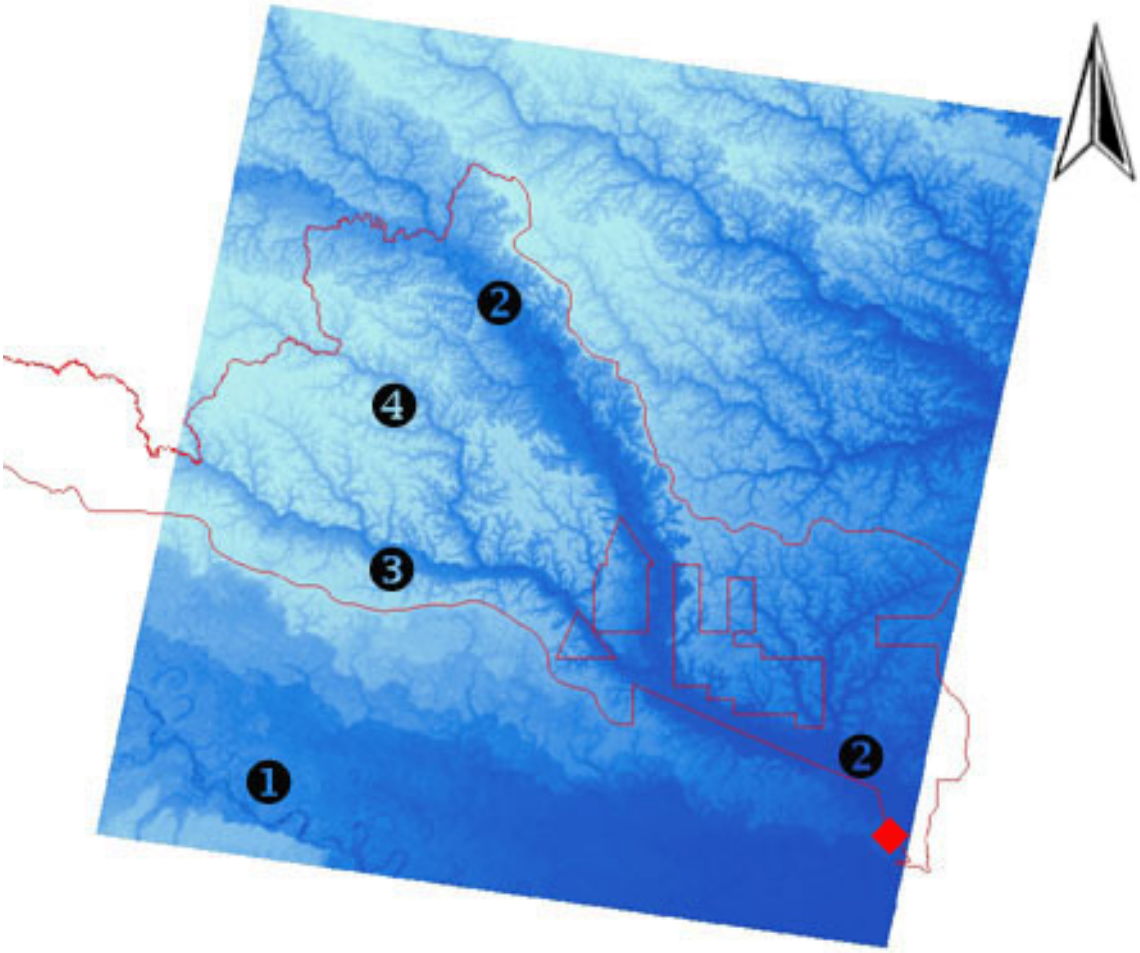

Figure 4.17: By viewing this Digital Elevation Model (DEM), it is clear that one of the dominant factors of our study landscape is its hydrological complexity. Like arteries and veins, the complex hydrology has driven landscape change, which has in turn driven the evolution and diversification of the rich flora and fauna of the region. The Amazon Rivers Program have discovered a highly diverse aquatic fauna in the region and are testing landscape-scale hypotheses regarding the evolution and diversification of the aquatic ecosystems. Faced with a high diversity of plant species in the study area, Los Amigos Botany is still in the stage of exploration and discovery. Collections have been made in the region of the station property (red diamond), and in selected areas along the Madre de Dios (1), Los Amigos (2), Amiguillos (3), and other (4) rivers. In collaboration with Mathias Tobler, team members of the Los Amigos Botany project will intensify focus on quantitative inventory and monitoring of plant diversity built within a framework of GIS and other tools for organization, analysis, visualization, and presentation of biotic and abiotic diversity patterns (betadiversity) across the landscape. For the systematic inventory and monitoring of plant diversity, we will apply the Los Amigos GIS to design, guide, and manage an intense collection strategy that maximizes the heterogeneity of habitats sampled. We will use this type of approach to test some on-going hypotheses about the evolution and diversification of plant diversity in the study area and region.

[26] This content is available online at <http://cnx.org/content/m11560/1.1/>.

4.3.2.8 Digital Elevation Model[27]

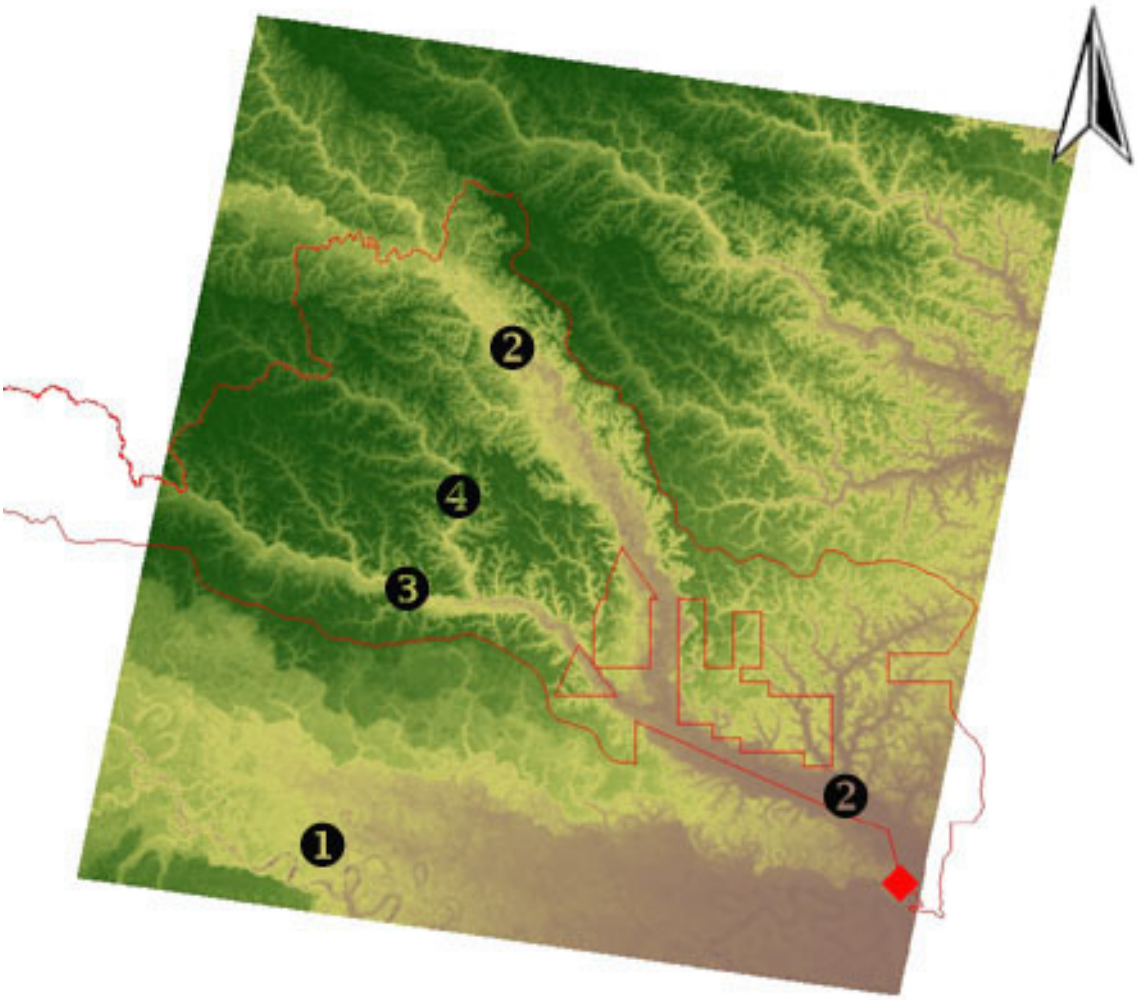

Figure 4.18: Another view of the Los Amigos DEM, showing the striking complexity and beauty of the hydrological/altitudinal interface. The station is marked with the red diamond, and the conservation boundary with red lines. (1) Madre de Dios River. (2) Los Amigos River. (3) Amiguillos River. (4) Mapa River.

[27] This content is available online at <http://cnx.org/content/m11561/1.1/>.

4.3.2.9 Hillshaded Digital Elevation Model[28]

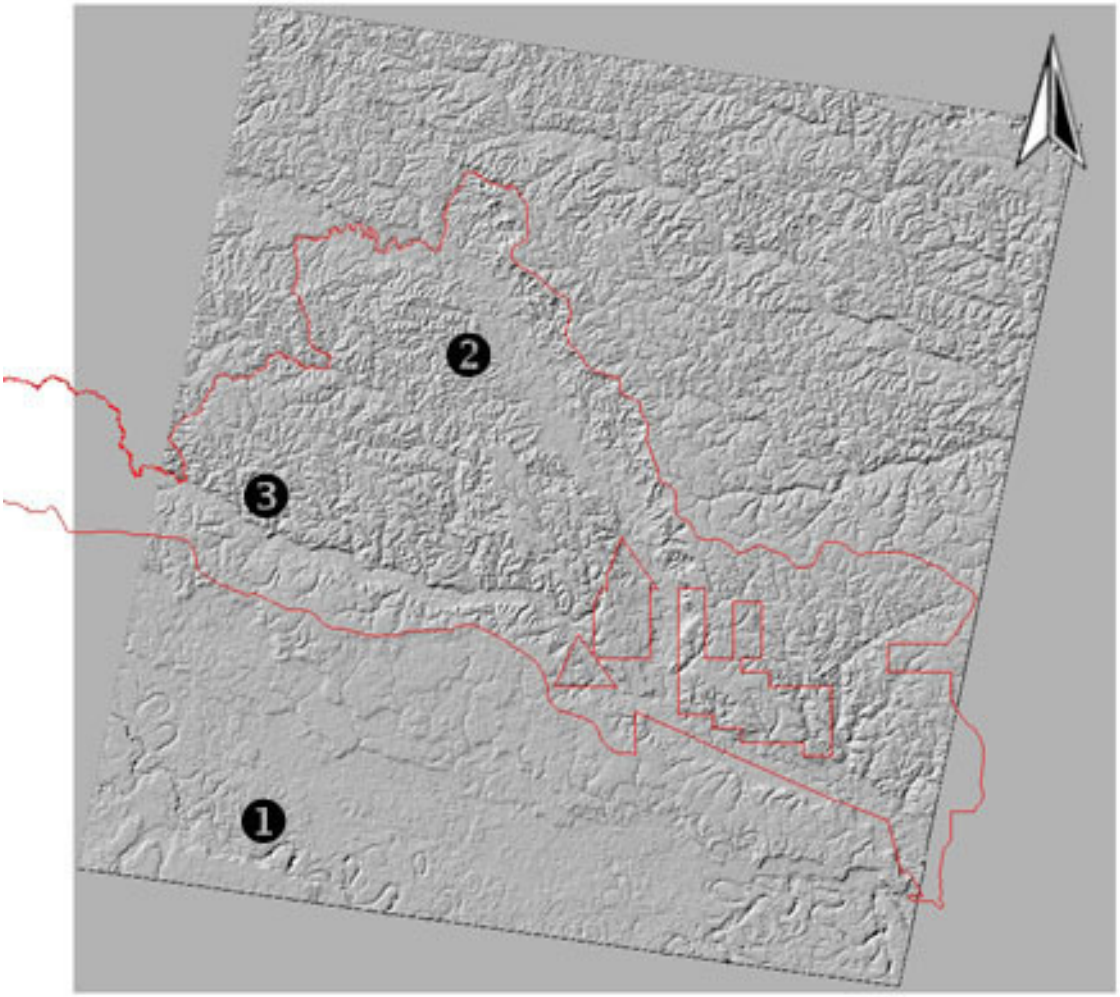

Figure 4.19: The DEM was used to generate a hill-shaded scene of the Los Amigos Conservation Area, pictured here. Rivers: (1) Madre de Dios. (2) Los Amigos River. (3) Amiguillos River. The change in elevation is not drastic, ranging from about 240 m in the Madre de Dios basin to about 350 m in the upper Amigos and Amiguillos watersheds. Both the DEM and our understanding of variation in elevation across the landscape deserve further investigation and ground-truthing. Los Amigos Botany is planning to do this during the next field season in January to February along with preliminary investigations on biotic and abiotic landscape-scale patterns of the Los Amigos landscape.

[28] This content is available online at <http://cnx.org/content/m11562/1.1/>.

4.3.2.10 Digital Elevation Model – 3-D View[29]

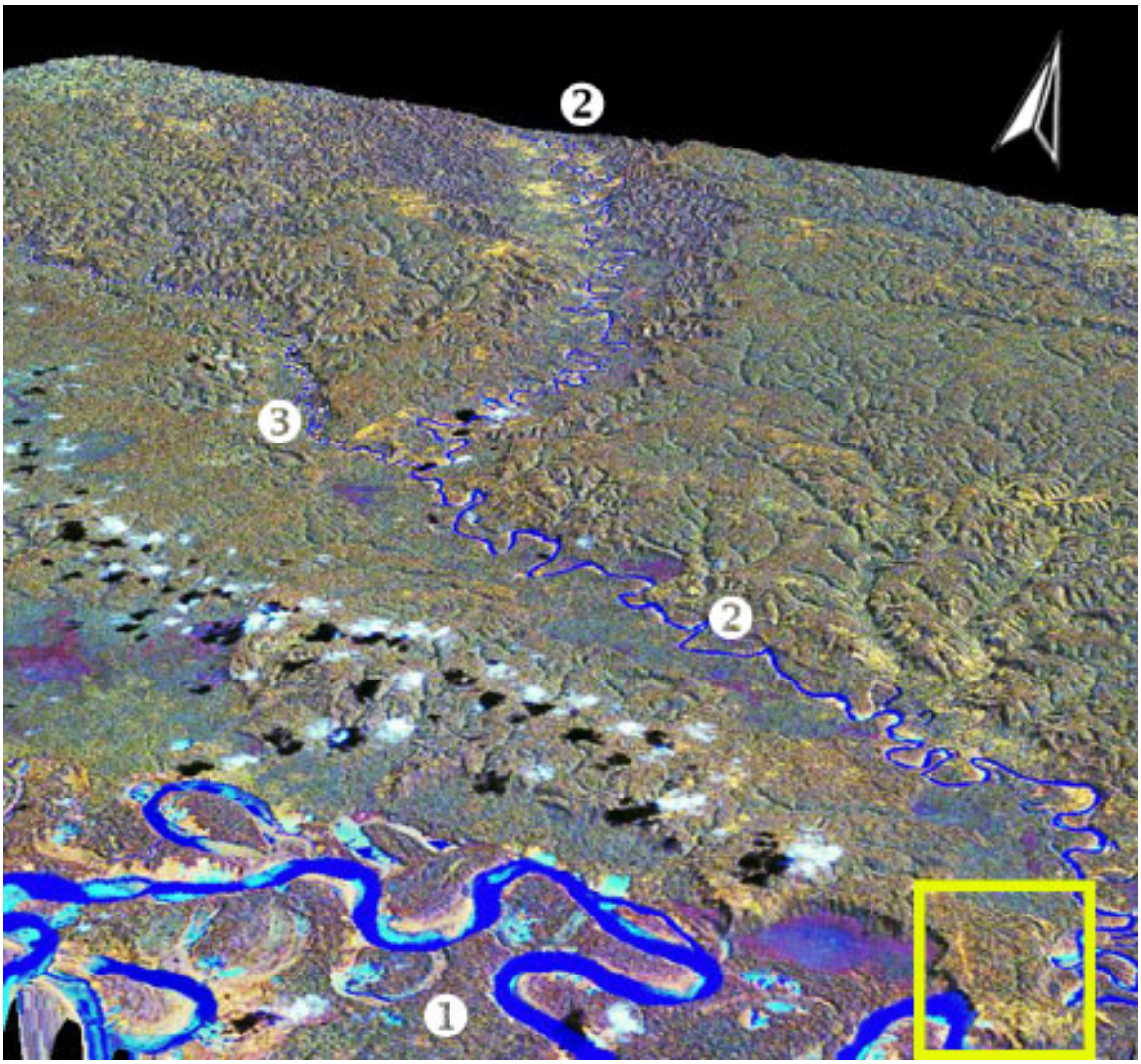

Figure 4.20: An overlay of the Landsat TM 2000 image on the DEM creates a most striking birds-eye view of the Los Amigos landscape. Here you view down the valley of the Los Amigos River (2) and the smaller watershed of the Amiguillos (3). The biological station (yellow outline) sits on a high terrace near the mouth of the Los Amigos River, overlooking the Madre de Dios basin.

[29] This content is available online at <http://cnx.org/content/m11563/1.1/>.

4.3.2.11 Digital Elevation Model - 3-D View[30]

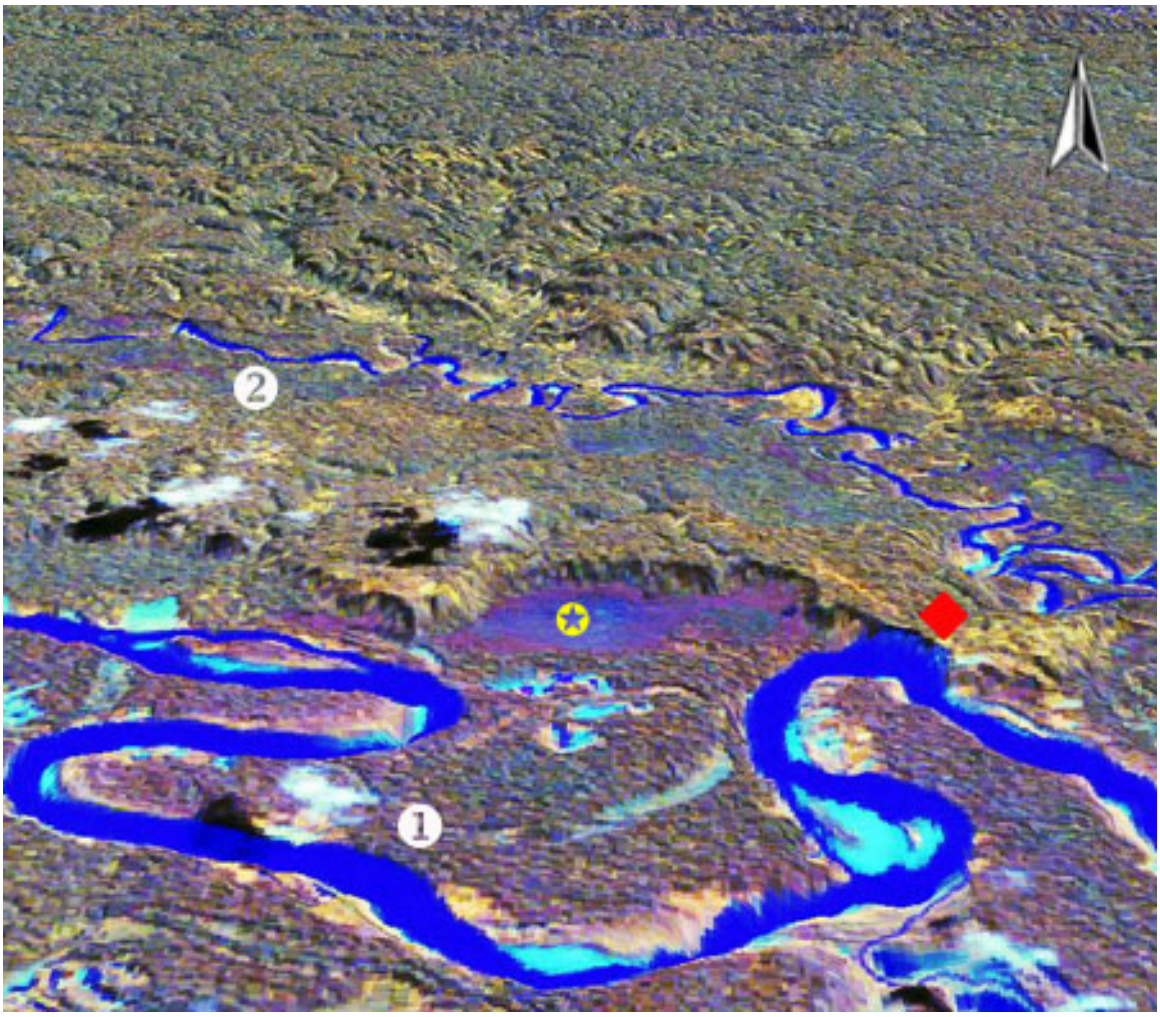

Figure 4.21: This scene provides a view of the terrace where the station sits (red diamond). DEM-generation from Aster images is not perfect, and due to error caused by reflectance patterns, some portions of the river appear to be waterfalls. There are no waterfalls along this portion of the Madre de Dios. Note the high banks between Madre de Dios (1) and the Los Amigos River (2). The Aguaje palm swamp (yellow star) sits between the high terrace and the floodplain. Just below the Aguaje palm swamp in this scene you can see light blue areas, which are past and present sites of gold-mining activities.

[30] This content is available online at <http://cnx.org/content/m11564/1.1/>.

4.3.2.12 Digital Elevation Model – 3-D View[31]

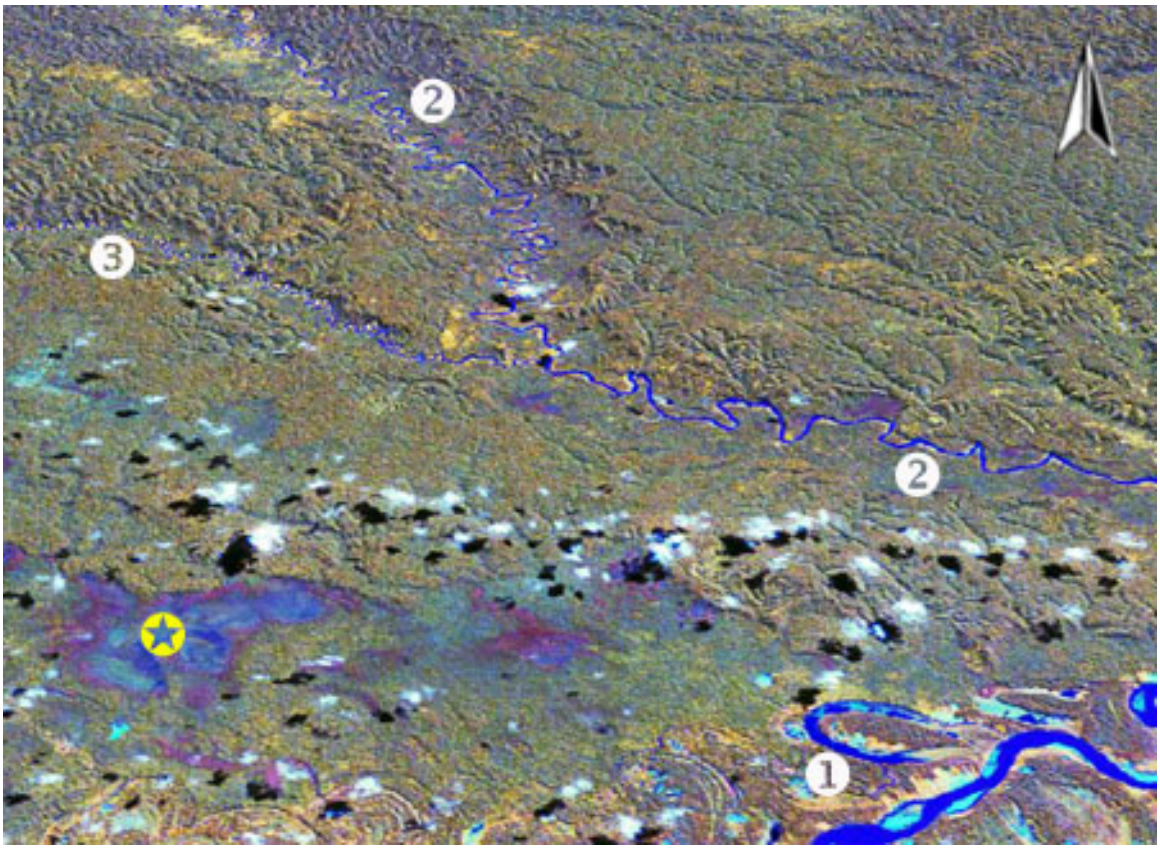

Figure 4.22: Another view of the Los Amigos landscape, from the Madre de Dios River (1) to the Los Amigos (2) and Amiguillos (3) rivers. Another zone dominated by Aguaje palms can be seen in this scene (yellow star). Notice the light cloud cover that hangs over the Madre de Dios basin.

[31] This content is available online at <http://cnx.org/content/m11565/1.2/>.

4.3.2.13 Digital Elevation Model – 3-D View[32]

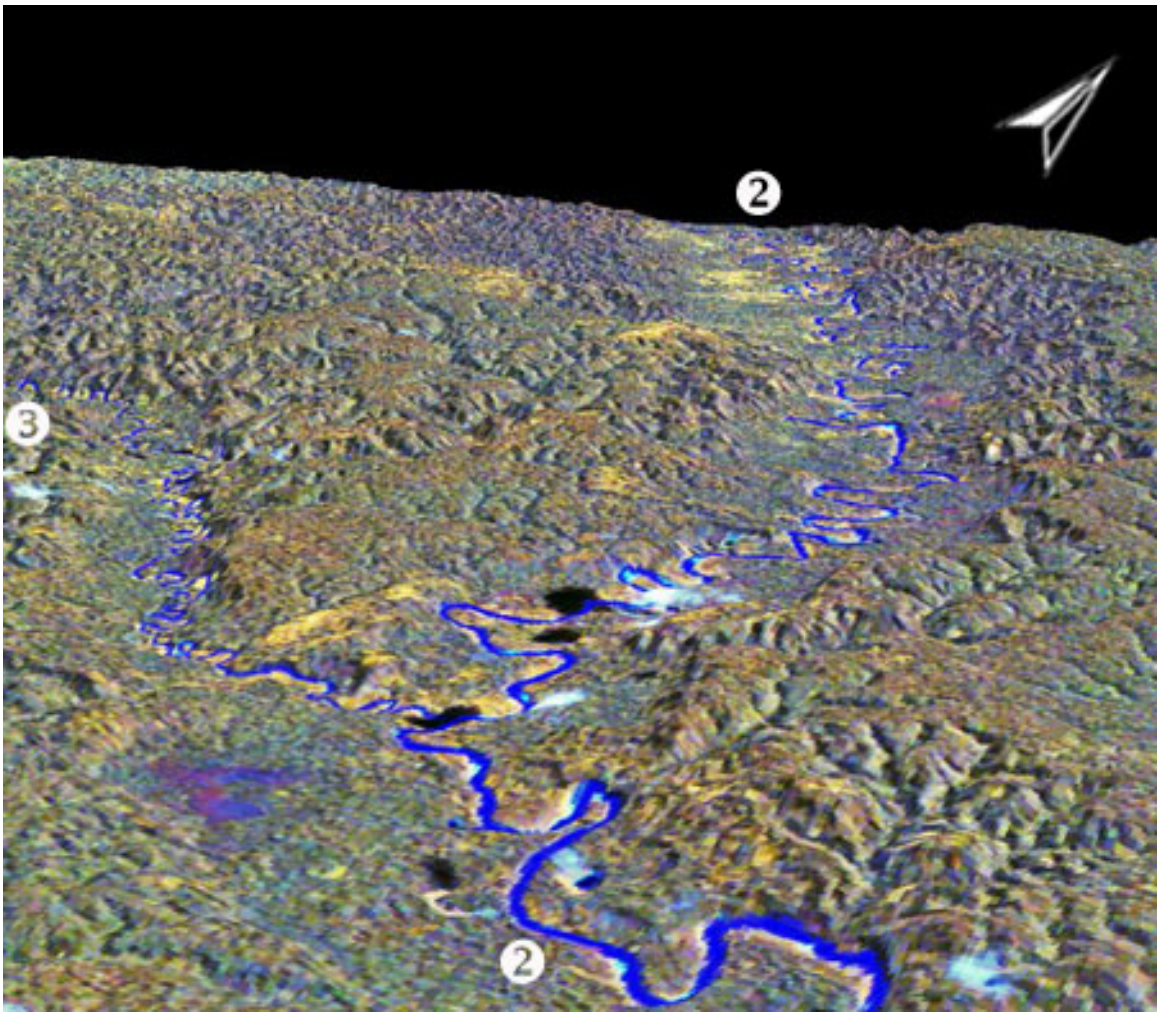

Figure 4.23: At higher magifications, the DEM-Landsat combination instill a sense of realism. Here you are viewing down the valley of the Los Amigos River (2) and across the dissected landscape on either side. The Amiguillos River is a smaller, more shallow river that is difficult to navigate in the dry season. In the far distance of the headwaters of these river systems, voluntarily uncontacted indigenous people live from the land while illegal loggers encroach on their existence, survival, and well-being, and the pristine nature of this landscape. With the offical status of the Los Amigos Conservation Area as a government- approved, private concession, the Los Amigos River now becomes a barrier to the entrance of illegal loggers and hunters, which provides protection to the uncontacted peoples upriver. Leaders at the Amazon Conservation Association (ACA) and La Associacion para la Conservacion de la Cuenca Amazonica (ACCA) have made the conservation concession a reality, which now provides the infrastructure for the protection of a tropical wilderness and long-term research and conservation activities.

[32] This content is available online at <http://cnx.org/content/m11566/1.1/>.

4.3.2.14 Digital Elevation Model –3-D View[33]

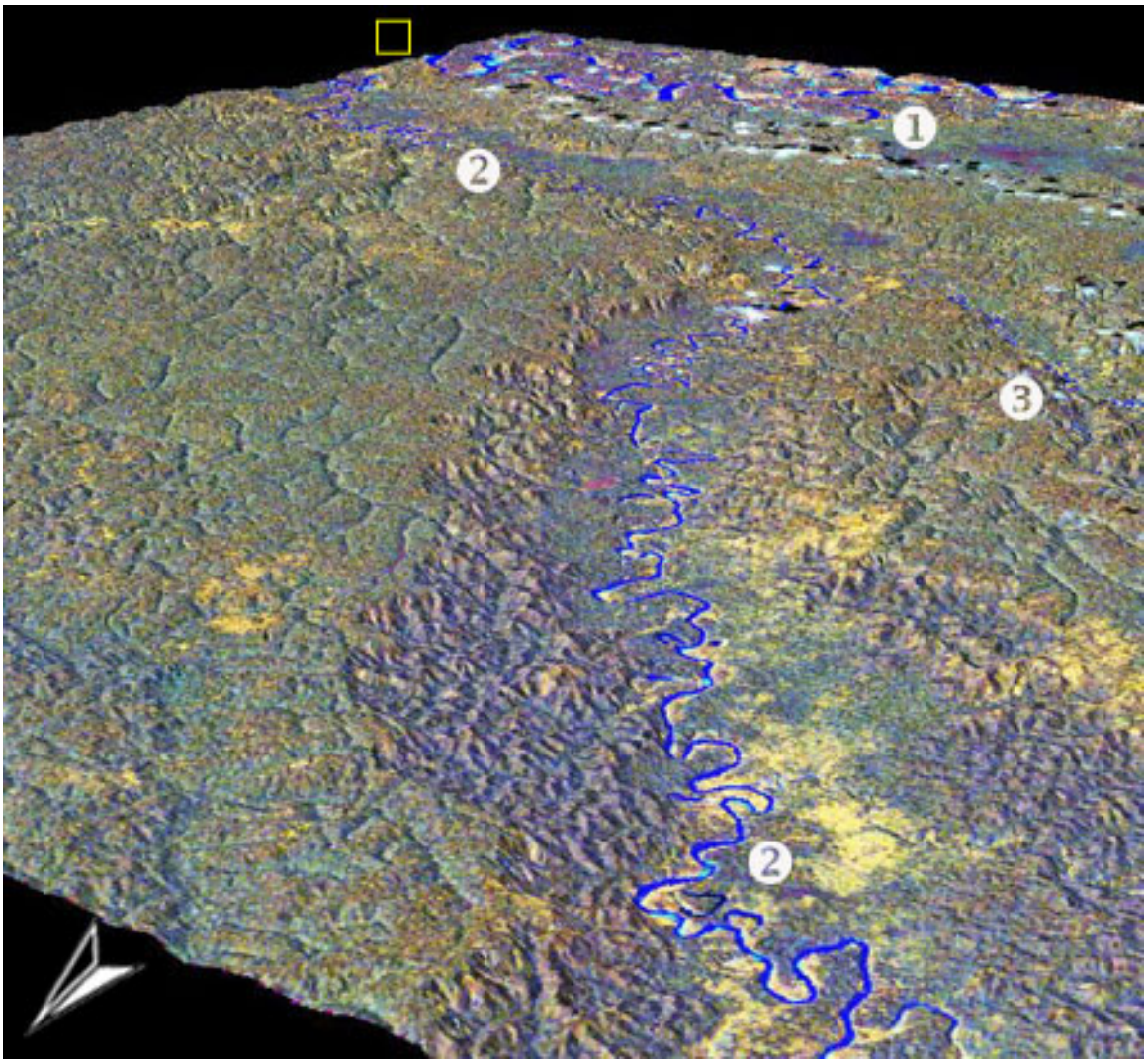

Figure 4.24: This scene provides a reverse view of the Los Amigos watershed. The biological station (yellow square) the Madre de Dios River (1) are located in the distant background of this scene. In the foreground one can see the Los Amigos River valley (2) and a hint of its tributary, the Amiguillos River (3).

[33] This content is available online at <http://cnx.org/content/m11567/1.1/>.

4.3.2.15 Digital Elevation Model –3-D View[34]

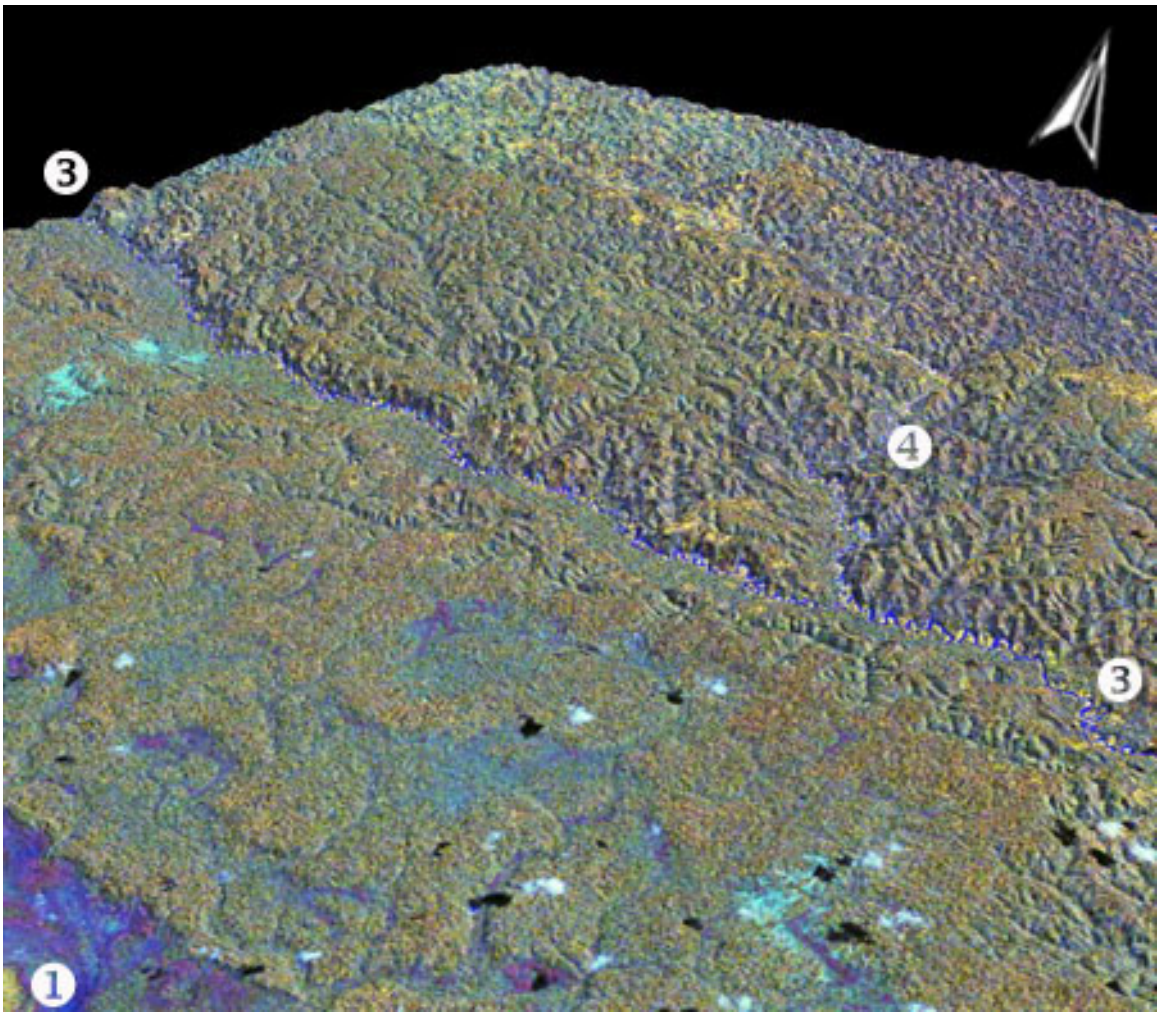

Figure 4.25: A three-dimensional view across the landscape, showing the Amiguillos River (3) and one of its tributaries (4). The vast floodplain of the Madre de Dios River (1) is a mosaic of forest and wetland that is driven by patterns of flooding, plus other abiotic factors. The light blue areas on the map, based on preliminary vegetation classification, appear to be large openings in the forest (upper left, below round three).

[34]This content is available online at <http://cnx.org/content/m11568/1.1/>.

4.3.2.16 Digital Elevation Model (3D)[35]

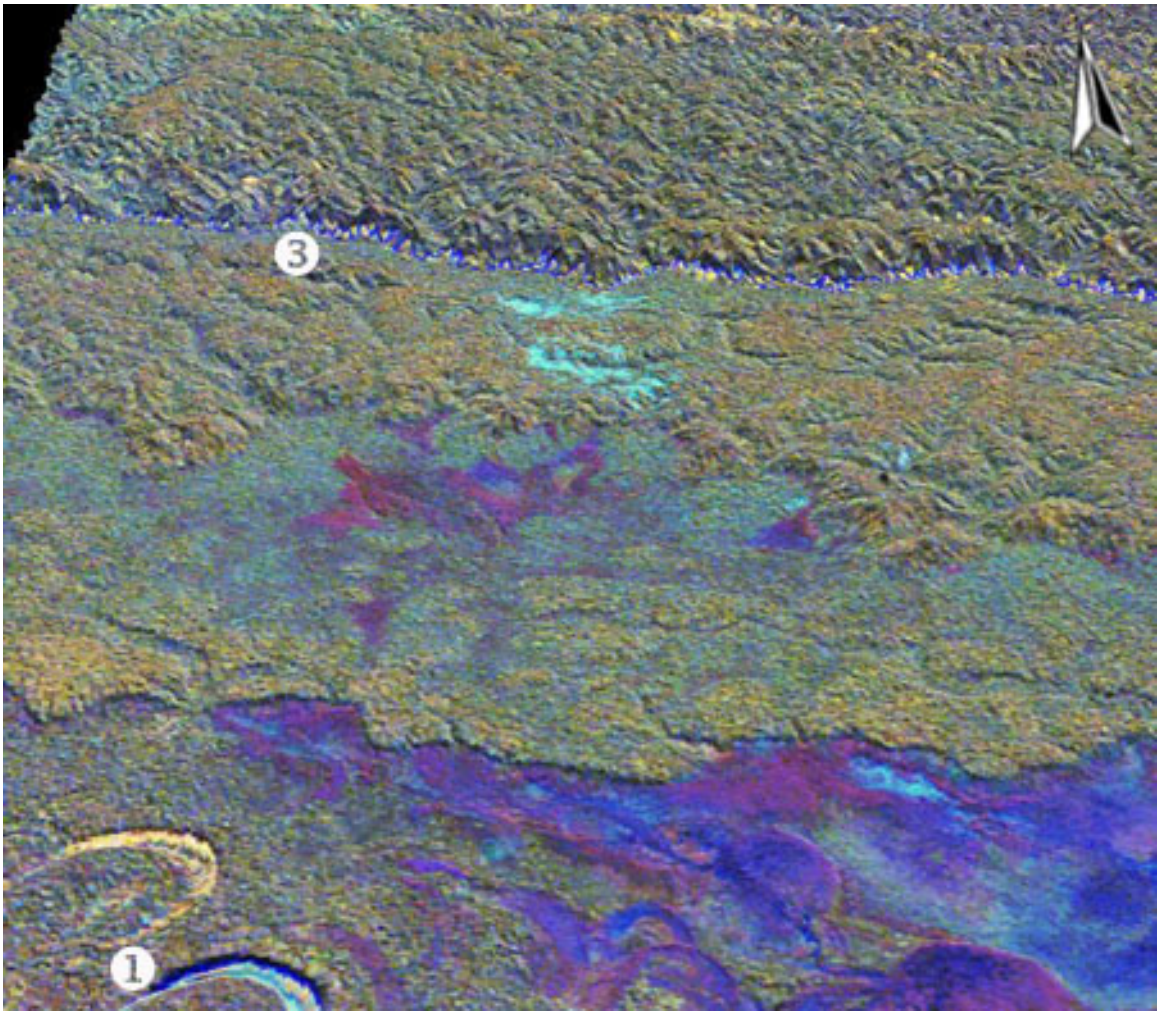

Figure 4.26: The availability of the Digital Elevation Model now allows for a carefully directed research design for sampling biotic and abiotic diversity. With an emphasis on plant diversity, the Los Amigos Botany team, consisting of an international group of Ph.D. scientists, graduate students, undergraduate students, and local field collaborators, will run landscape-scale transects that traverse a diversity of habitats. In the case of this scene, we will conduct systematic inventory and monitoring along several transects that connect the Madre de Dios floodplain forests (1) to the distant dissected terrain beyond the Amiguillos (3) to the Los Amigos River (not visible in this scene, but to north). We will ask questions pertaining to the distribution and variation of vegetation across the landscape, and use our quantitative and qualitative data to devise a classification. Preliminary vegetation maps have been developed, but much ground-truthing is needed to make these maps accurate and reliable.

[35] This content is available online at <http://cnx.org/content/m11569/1.1/>.

4.3.2.17 JERS-1 Synthetic Aperture Radar (SAR) Image[36]

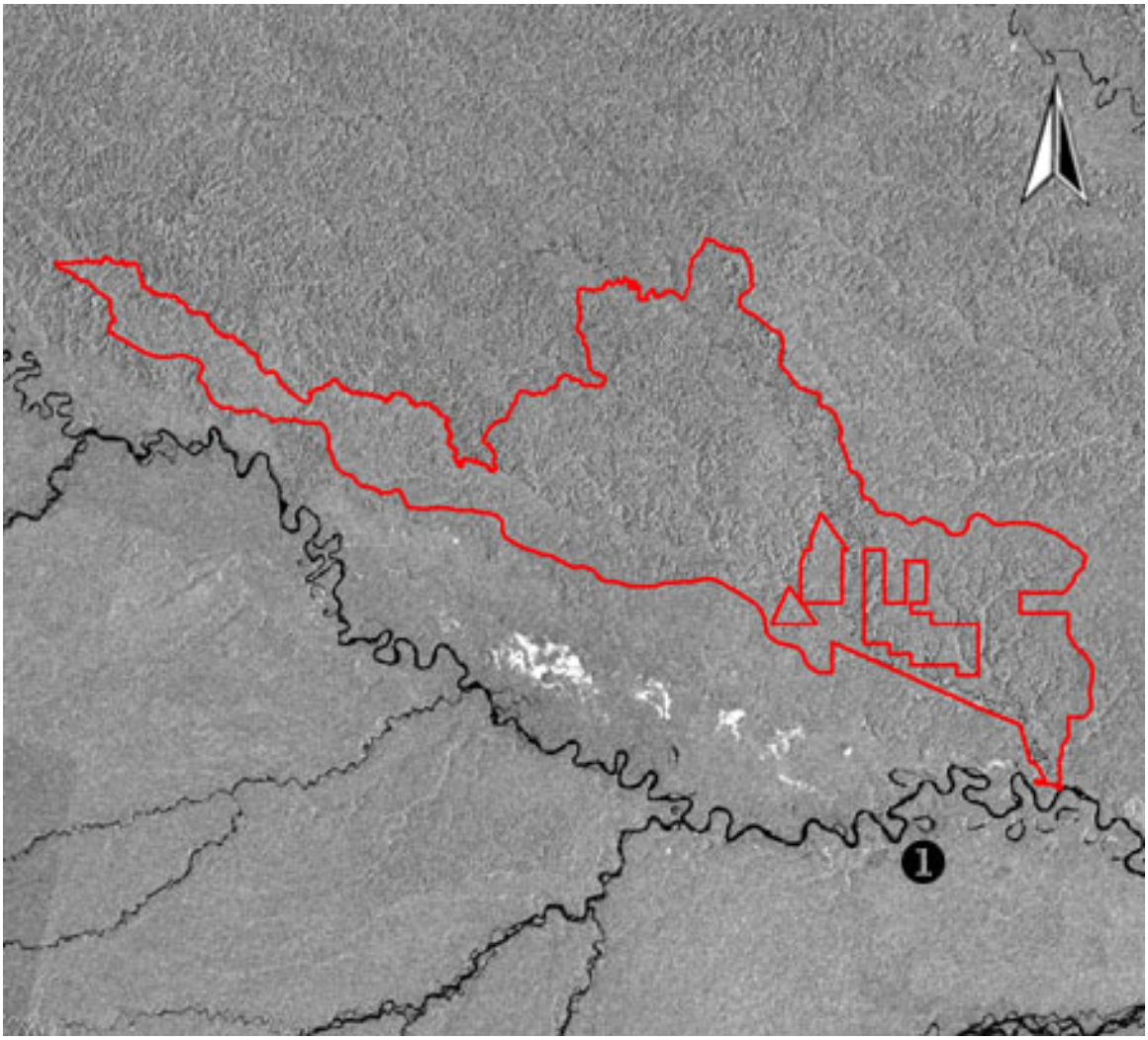

Figure 4.27: This image shows a mosaic of scenes taken by JERS-1 Synthetic Aperture Radar (SAR) as part of the Global Rainforest Mapping Project Notice the meandering of the Madre de Dios River (1). It is larger than the Los Amigos River, which is not visible on this radar image within the concession boundary (red line) at this scale. White areas show wetlands, in this case Aguajales.

[36]This content is available online at <http://cnx.org/content/m11570/1.2/>.

4.3.2.18 Distribution of Aguaje palm swamps in the Madre de Dios River basin[37]

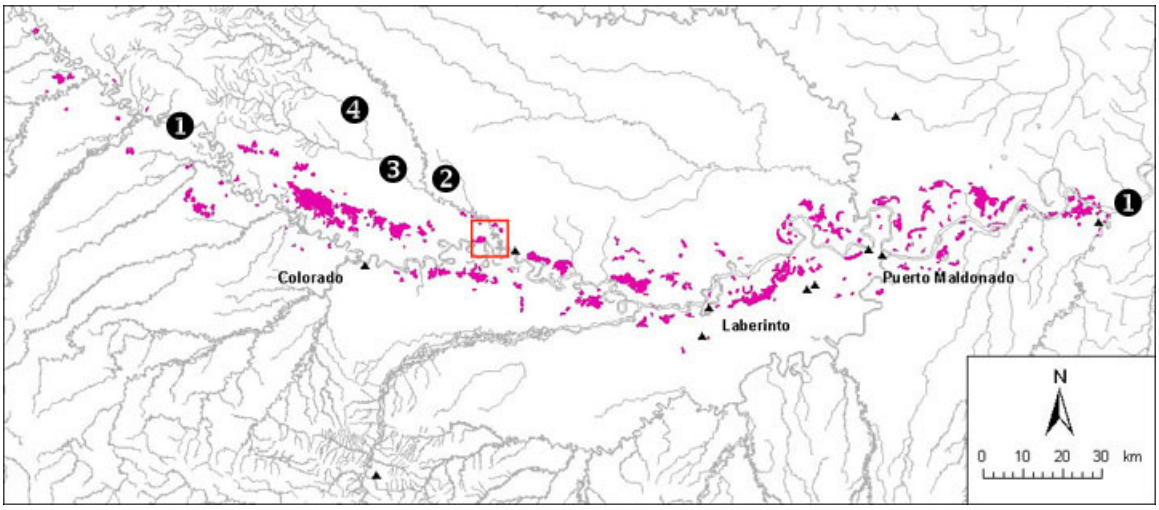

Figure 4.28: As part of Los Amigos Botany, we have initiated the Aguajal Project to study the ecology, diversity, distribution, economic potential, and sustainable use/management of the Aguaje palm (Mauritia flexuosa) and its ecosystem. This output image from GIS depicts the distribution of Aguaje palm swamps in the Madre de Dios River basin. Mathias Tobler generated this image by extracting Aguaje palm swamps from Landsat satellite imagery. We are using this map in conjunction with other geospatial data and imagery to guide us in our field work and analysis of this wetland ecosystem. See the Aguajal Project photographic essay for more information about this ecosystem.

[37] This content is available online at <http://cnx.org/content/m11571/1.1/>.

4.3.2.19 Aguaje Palm (Mauritia flexuosa) Palm Swamp – Aguajal Ecosystem[38]

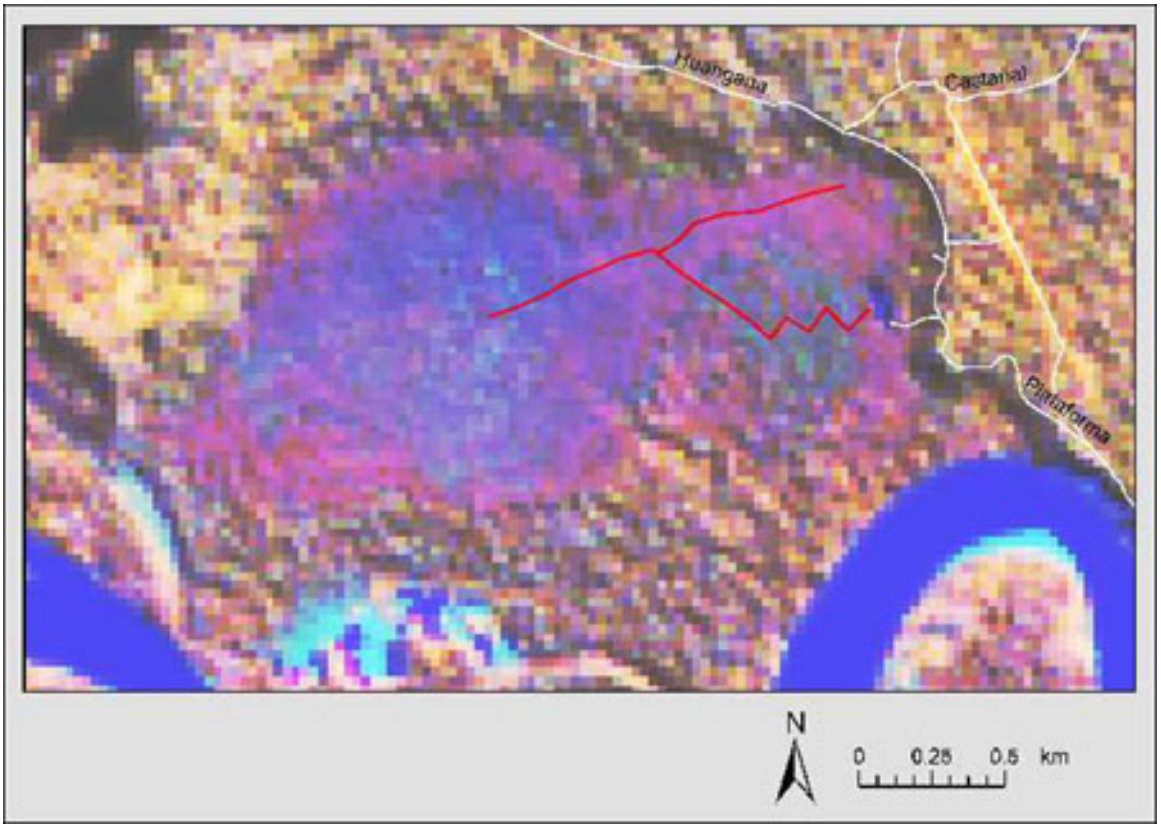

Figure 4.29: During July-September 2002, we executed a study of the density, phenology, and fruit production of the Aguaje palm (Mauritia flexuosa) along about seven kilometers of aguajal transects. These transects started in flooded forests and ended in the middle of wetland savannahs dominated by the Aguaje palm. The aguajal shows a mosaic of blue and purple pixels on the Landsat image. The colors correlate with forest canopy cover and water. The open blue areas are savannahs with dispersed Aguaje palms. The pink-purple areas are more mixed forest, still dominated by the Aguaje palm. In the open savannahs, we were excited to discover many interesting plants, such as eight species of orchids, including six terrestrial species and two species of Vanilla. Various shrub and small tree species collected in the swamps represent families that are better known from higher elevation forests in the Andes, such as a Hedyosmum species (Chloranthaceae) currently under investigation in the New York Botanical Garden Herbarium. It has become clear that the Aguaje palm ecosystem is worth of study for various reasons. One of those reasons is that it will provide an interesting model system for studying the origin, evolution, and diversification of the flora of Madre de Dios. Results from our aguajal research conducted July-September will be submitted for publication in a peer-reviewed journal, with focus on the patterns of density, distribution, fruit production, and preliminary ecology of the Aguaje palm wetlands within and in the vicinity of the Los Amigos Conservation Area.

[38] This content is available online at <http://cnx.org/content/m11572/1.1/>.

4.3.2.20 ACA GIS – Meta-database[39]

Figure 4.30: Information on all the available datasets in the Los Amigos GIS is stored in a meta-database to facilitate the use of the data by other researchers and students. Depicted here is one form page of the Los Amigos GIS Metadatabase.

[39] This content is available online at <http://cnx.org/content/m11573/1.1/>.

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