Tropical Biology:

Linking Tropical Biology with Human Dimensions

Program and Abstracts

The Annual Meeting of the Association for Tropical Biology and Conservation
July 15-19 2007 Morelia, Mexico

Hosted by

Centro de Investigaciones en Ecosistemas
Universidad Nacional Autónoma de Mexico

Universidad Michoacana de San Nicolás de Hidalgo, Mexico

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Introduction

We are honored to host the annual meeting of the Association for Tropical Biology and Conservation 2007 in Morelia, Michoacán, Mexico. This is a record year for ATBC, we received more than 700 contributions from all the tropical regions of the world. These include 222 presentations in 23 symposia, 226 presentations in 41 contributed oral sessions and 204 posters. There will be 10 simultaneous sessions during the morning and afternoon during the four days of the meeting. Approximately 60% of these contributions are related to genetics, ecology, evolution, systematics, and taxonomy and about 40% involve issues related to human dimensions of tropical biology. A special panel will meet to address issues related to the role of women in tropical biology. In addition, there will be two workshops, one on the use of stable isotopes in tropical biology and another one on acoustic methods for bat monitoring.

A special effort was made to enrich the meeting with a variety of keynote lectures that will be delivered by outstanding academic leaders representing diverse fields. We have two keynote speakers scheduled for each day. These speakers will address topics related to evolution and conservation genetics, ecological theory, politics and agroecosystems, evolution and conservation of plant pollinator systems, and linking tropical biology with human dimensions.

This year we have the honor of hosting delegates from 34 countries, from five continents and 365 academic institutions. Thirty three percent of the delegates are masters and PhD students. In sum, this year's meeting reflects a very diverse scientific society that is represented by academics from all over the world coming from many different cultures and presenting studies from many different topics.

Based on the mission, objectives and principles of ATBC, the meeting in Morelia will pursue key research avenues reviewed by Bawa et al (2004, Biotropica 36: 437-446) in "Beyond Paradise". Our goal is to help link tropical biology with human dimensions. The meeting will cover a wide array of basic and applied research topics on tropical biology and conservation, including: ecology and conservation of tropical vertebrates and arthropods, ecology of seed dispersal, ecosystem services, ethnobiology, evolution and genetic diversity of plants, forest fragmentation, forest management and selective logging, global change in tropical ecosystems, plant animal interactions, human development and sustainability, use of non-timber products, litterfal and soil ecology, phylogeny and phylogeography of plants, plant physiological ecology, restoration of tropical ecosystems, and social and economic drivers of change in tropical ecosystems.

As an introduction for the incoming members and participants, we would like to let you know that The Association for Tropical Biology and Conservation (ATBC) was founded in 1963. It is international in scope, membership, and objectives, functioning as a global multi-faceted body to promote research, education, conservation, and communication of tropical biology and also to foster the exchange of ideas among biologists working in tropical environments. The 2007 annual meeting in Morelia, Mexico, is hosted by the Centro de Investigaciones en Ecosistemas (CIEco) of the Universidad Nacional Autónoma de México (UNAM). The venue will be in the Centro Cultural Universitario of the Universidad Michoacana de San Nicolás de Hidalgo and the Colegio Primitivo de San Nicolás de Hidalgo, both historical buildings in Morelia.

Dr. Mauricio Quesada
Centro de Investigaciones en Ecosistemas
Universidad Nacional Autónoma de México
Organizer of ATBC2007

Dr. Miguel Martinez-Ramos
Centro de Investigaciones en Ecosistemas
Universidad Nacional Autónoma de México
Organizer of ATBC2007

ATBC 2007 Meeting

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INTRODUCTION

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Registration

Registration to the meeting will start on Sunday July 15 from 10:00 to 18:00 and will continue with the same schedule through the week. The Registration room is in the second floor of the Colegio Primitivo de San Nicolas de Hidalgo (please see map).

Program Organization

The ATBC meeting will have 4 types of presentations: Keynote talks, Symposia, Oral talks, and Posters.

Nine Keynote talks will be given by renowned scientists. Two talks per day, one at 8:30 and the other one at 18:30 from Monday 16 to Thursday 19. There will be one more talk on Sunday evening at the opening ceremony.

Symposia and Oral presentations will be held each morning and afternoon from Monday July 16 to Thursday July 19 from 10:00 to 12:30 and from 14:00 to 16:20.

Posters will be shown all day everyday according to the study topics indicated in the program. Each presenter will set up their posters at 9:30 am on the day of the presentation but will formally present his/her work from 16:00 to 17:45.

Each participant will receive two documents after registration. The first one contains the main general program of the meeting and a detailed schedule with the Symposia, Oral presentations and Posters that includes the day, time, title and authors of each contributions. The second document contains the abstracts of each contribution organized in the order of presentation by day and time. Both documents also include several maps that will help locate the buildings and the rooms where contributions will be presented. Both documents have an author index at the end of each book. This author index is mainly organized by the last name (first last name for compound last names), however due to inconsistencies in the order of entering the name information in the registration process, sometimes it is organized by first name. If you do not find the person you are looking for by last name, please try by first name. We apologize for this inconvenience.

Instructions for Presenters

The presenting author of each talk for symposium or oral presentation should turn in their talk at the registration desk the day before their talk is to be presented. The following format should be used for the name of the file. First put S or O indicating Symposium or Oral Session. Follow this with an abbreviation of the first 3 main words of the title of the symposium or oral session. Finally, put the last name of the first author of the presentation and the hour of your presentation. Example: OEcolConsMamStoner10:00. Please comply with this labeling system, as it will greatly help in the organization of each session and reduce the amount of errors.

Please put posters up in the morning of the day of your poster presentation. Posters will be placed in the hallway of the Colegio Primitivo de San Nicolás de Hidalgo. The posters will remain up all day long. We ask that all authors are present at their posters 16:20-17:45. Posters must be taken down at the end of the session.

	SYMPOSIA (MORNING)			
	MONDAY JULY 16	TUESDAY JULY 17	WEDNESDAY JULY 18	THURSDAY JULY 19
Room 1: Teatro José Ruben Romero Bulding: Teatro José Ruben Romero (Auditorium)	**#1 Aide** The influence of human demography and agriculture on natural systems in the Neotropics	**# 8 Chazdon** Managing Tropical Agricultural Landscapes to Enhance Biodiversity	**# 12 Balvanera** Approaches to the study of ecosystems services provided by tropical systems	**# 19 Born** Natural Services in local context: Opportunities and barriers to uptake
Room 2: Conservatorio de las Rosas (Auditorium) Building: Conservatorio de las Rosas	**#2 Vulinec** Primates at Risk: Conservation Concerns and Indigenous Anthropogenic Landscapes	**# 9 Solorzano** Conservation Genetics of Tropical Vertebrates	**# 13 Laurance** Debating the Tropical Extinction Crisis	**# 20 Jansen** Seed dispersal and seed predation in Neotropical palms
Room 3: Cervantes Saavedra (Second Floor) Building: Colegio Primitivo de San Nicolás de Hidalgo	**# 3 Jaramillo** The impact of plant phylogenies on tropical ecology and evolutionary studies	**# 10 Mueller** Ecological theory and tropical ecology: bridging the gap for mutual gain	**# 14 Cavender** Tropical Oaks: Diversity, Ecology and Conservation	**# 21 Paz** Functional Ecology of Tropical Plant Communities
Room 4: Sala Rectores (Second Floor) Building: Centro Cultural Universitario	**#4 Nogueira** Ecology of insect x plant interactions in the tropic		**# 15 Kress** Diversity and Evolution of Pollination and Mating Systems of Tropical Plants	**# 22 Armbruster** Pollination in Natural and Fragmented Communities
Room 5: Aula Mater (First Floor) Building: Colegio Primitivo de San Nicolás de Hidalgo		**# 7 Sánchez & Quesada** TROPI-DRY: Human and Biophysical Dimensions of Neotropical Dry Forests: Results from a Collaborative Project	**# 16 Hietz** Ecology of coffee agro-ecosystems	**# 23 Guevara** Biosphere reserves: a sound strategy for the conservation of biological diversity and development in the American tropics?

ORAL PRESENTATIONS (MORNING)

	MONDAY, JULY 16	TUESDAY JULY 17	WEDNESDAY JULY 18	THURSDAY JULY 19
Room 6: Sala 2 (Second Floor) Building: Centro Cultural Universitario	Forest fragmentation and conservation genetics of plants	Herbivory	Ecology & conservation of birds. Part I	Succession in tropical ecosystems
Room 7: Miguel Hidalgo (Second Floor) Building:Colegio Primitivo de San Nicolás de Hidalgo	Restoration of tropical ecosystems. Part I	Biodiversity inventories and conservation. Part I	Forest management and selective logging. Part I	Phylogeny and phylogeography of plants
Room 8: Enrique Shuls (Second Floor) Building:Colegio Primitivo de San Nicolás de Hidalgo	Biological & social bases for sustainable use of NTP. Part I	Ecology and conservation of mammals. Part I	Ecology, evolution and conservation of arthropods. Part I	The ecological role of ants in tropical ecosystems.Part I
Room 9: Aristóteles (Second Floor) Building:Colegio Primitivo de San Nicolás de Hidalgo	Population and community ecology of tropical systems. Part I	Social and economic drivers of change of tropical ecosystems. Part I	Human development and sustainability. Part I	Invasive species in the tropics
Room 10: Manuel Altamirano (Second Floor) Building:Colegio Primitivo de San Nicolás de Hidalgo	Ecology of seed dispersal. Part I	Ethnobiology	Plant physiological ecology. Part I	Ecology and conservation of amphibians and reptiles

	SYMPOSIA (AFTERNOON)			
	MONDAY JULY 16	TUESDAYJULY 17	WEDNESDAY JULY 18	THURSDAY JULY 19
Room 1: Teatro José Ruben Romero Bulding: Teatro José Ruben Romero (Auditorium)	**#1 Aide** The influence of human demography and agriculture on natural systems in the Neotropics	**# 8 Chazdon** Managing Tropical Agricultural Landscapes to Enhance Biodiversity	**# 12 Balvanera** Approaches to the study of ecosystems services provided by tropical systems	**# 24 Boom** Linking Tropical Biology with Human Dimensions in the West Indies
Room 2: Auditóriumrio de las Rosas (Auditórium) Building: Conservatorio de las Rosas	**# 5 Henry & Stoner** Landscape ecology of bats: from population to community level		**# 17 Thompson** The Evolutionary Ecology of Multispecific Interactions in Changing Environments	**# 20 Jansen** Seed dispersal and seed predation in Neotropical palms
Room 3: Cervantes Saavedra (Second Floor) Building: Colegio Primitivo de San Nicolás de Hidalgo	**# 3 Jaramillo** The impact of plant phylogenies on tropical ecology and evolutionary studies		**# 14 Cavender** Tropical Oaks: Diversity, Ecology and Conservation	**# 21 Paz** Functional Ecology of Tropical Plant Communities
Room 4: Sala Rectores (Second Floor) Building: Centro Cultural Universitario	**# 6 Marquis** Gradients in plant-herbivore interactions involving tropical systems	**# 11 Luizao** Conservation of the Biodiversity and of the Environmental Services of the Forest: Basis for the Sustainable Development of the Amazon	**# 18 Perez** Ecology and management of climbing plants	
Room 5: Aula Mater (First Floor) Building: Colegio Primitivo de San Nicolás de Hidalgo	**# 7 Sánchez & Quesada** TROPI-DRY: Human and Biophysical Dimensions of Neotropical Dry Forests: Results from a Collaborative Research Network	**# 7 Sánchez & Quesada** TROPI-DRY: Human and Biophysical Dimensions of Neotropical Dry Forests: Results from a Collaborative project	**# 16 Hietz** Ecology of coffee agro-ecosystems	**# 23 Guevara** Biosphere reserves: a sound strategy for the conservation of biological diversity and development in the American tropics?

	ORAL PRESENTATIONS (AFTERNOON)			
	MONDAY JULY 16	TUESDAY JULY 17	WEDNESDAY JULY 18	THURSDAY JULY 19
Room 6: Sala 2 (Second Floor) Building: Centro Cultural Universitario	Effects of Forest Fragmentation on Tropical Systems	Pollination and plant reproduction. Part I	Ecology & conservation of birds. Part II	Pollination and plant reproduction. Part II
Room 7: Miguel Hidalgo (Second Floor) Building: Colegio Primitivo de San Nicolás de Hidalgo	Restoration of tropical ecosystems. Part II	Biodiversity inventories and conservation. Part II	Forest management and selective logging. Part II	Litterfal and soil ecology
Room 8: Enrique Shuls (Second Floor) Building: Colegio Primitivo de San Nicolás de Hidalgo	Biological & social bases for sustainable use of NTP. Part II	Ecology and conservation of mammals. Part II	Ecology, evolution and conservation of arthropods. Part II	The ecological role of ants in tropical ecosystems. Part II
Room 9: Aristóteles (Second Floor) Building: Colegio Primitivo de San Nicolás de Hidalgo	Population and community ecology of tropical systems. Part II	Social and economic drivers of change of tropical ecosystems. Part II	Human development and sustainability. Part II	Seed and seedling ecology
Room 10: Manuel Altamirano (Second Floor) Building: Colegio Primitivo de San Nicolás de Hidalgo	Ecology of seed dispersal. Part II	Ecosystems services	Plant physiological ecology. Part II	Evolution and genetic diversity of plants
Room 11: Erodoto (First Floor) Building: Colegio Primitivo de San Nicolás de Hidalgo			Global Change	

POSTERS (AFTERNOON)

MONDAY JULY 16	TUESDAY JULY 17	WEDNESDAY JULY 18	THURSDAY JULY 19
Restoration of tropical ecology	Herbivory	Pollination and plant reproduction	Phenology
Forest fragmentation & conservation genetics	Biodiversity inventories & conservation	Plant physiological ecology	Plant communities
Forest structure and dynamics	Ecology and conservation of vertebrates		Ecosystem management
Tropi-Dry			Human development & tropical ecosystems

Building: Colegio Primitivo de San Nicolás de Hidalgo

Format presentations:

16:00 to 17:45

Presenters should set up posters at 9:30 AM the day of the presentation.

Abstracts of Keynote lectures at the ATBC 2007

All of the keynote talks will be presented in the Centro Cultural Universitario of the Universidad Michoacana de San Nicolás de Hidalgo.

Sunday July 15, 19:00
Challenges for Tropical Biology in the context of the future of Mexico and the world
Dr. José Sarukhán
Instituto de Ecología
Universidad Nacional Autónoma de México

Monday July 16, 8:30
Unshackling Tropical Biology
Dr. Kamaljit S. Bawa
Distinguished Professor
Department of Biology
University of Massachusetts Boston

Monday July 16, 18:00
Contradictions between Conservation and Use of Tropical Ecosystems in Mexico
M. en C. Julia Carabias
Facultad de Ciencias, UNAM
Universidad Nacional Autónoma de México

Tuesday July 17, 8:30
Ecological theory, political reality and the role of agroecosystems in a new conservation paradigm
Dr. John Vandermeer
Professor
Department of Ecology and Evolutionary Biology
University of Michigan

Recent advances in ecological theory emphasize the importance of spatial dynamics in the maintenance of biodiversity in natural communities. Political arrangements for the past century have resulted in a particular spatial reality in most tropical landscapes in which the natural spatial dynamics of ecosystems are embedded. This embedding is invariably with a larger matrix of agroecosystems. The combination of this ecological theory and the political reality suggests that a focus on those agroecosystems is the most rational way to promote long-term conservation of biodiversity.

Tuesday July 17, 18:00
Evolutionary conservation science in practice: designing evolutionary and ecological landscapes of the future
Dr. Victoria Sork
Professor and Chair,
Department of Ecology & Evolutionary Biology and Institute of the Environment
University of California, Los Angeles

A critical challenge for conservation biology is to develop effective strategies for the preservation of areas that include critically important individual species, communities, habitats, and ecosystems. Globally, one decisive factor has been the use of "biodiversity hotspots" where species diversity is so high that special conservation efforts have been deployed to document the extant species before they disappear and to protect these areas from destruction by establishing ecological reserves. Not only in these areas but also throughout the world, we need to set aside areas for preservation if we are to protect species, habitats, and ecosystems of interest. So far, the criteria for selection of areas for preservation and the creation of reserves have been based on ecological, economic, and opportunistic factors. Increasingly, many biologists have been arguing that the design of reserves should include another criterion--the preservation of ecological and evolutionary processes that would allow populations, communities, and ecosystems to persist into the future, not simply be "preserved" based on current distributions. Given the dramatic human-induced land use alteration and global climate change occurring at an unprecedented rate, this emphasis on process is essential. In California, ongoing efforts are underway to identify ways of putting evolutionary conservation science in practice. Here, I will review analyses of California species that use biogeographic genetic information as an additional means of identifying regions of high evolutionary activity in the past and high evolutionary significance for the future. Then, I will present an analysis of the geographical genetic patterns within a single California endemic tree species, Quercus lobata, as a means of identifying regions of high evolutionary importance. Finally, I will describe how this information can be used for the design of reserve networks throughout the state of California and discuss how this example might be applied generally.

Wednesday July 18, 8:30
Recent Developments in Conservation Genetics
Dr. Philip Hedrick
Ullman Professor of Biology
Life Sciences Faculty
Arizona State University

Wednesday July 18, 18:00
Floral Specialisation: From developmental precision to ecosystem services
Dr. Scott Armbruster
Professor
University of Portsmouth

Floral specialisation has been the focus of recent research by both ecologists and evolutionary biologists. Most attention has been paid to specialisation via reliance on few species or functional groups of pollinators, often by restricting access to rewards. Less attention has been paid to other axes of floral specialization, including chemical specialization of rewards, temporal specialization (seasonal or diel), and specialized floral symmetry, modularity, and integration, with resulting effects on precision and accuracy of pollen placement on, and pick up from pollinators. Consideration of these additional axes of specialization in a phylogenetic context suggests that floral specialization is common, especially in the tropics, and has evolved frequently. The nature of floral specialization may influence the degree of interdependence of community members and the sensitivity of ecosystems and their services to disturbance and habitat loss.

Thursday, July 19, 8:30

The Urbanizing Amazon: Reconfiguring resource use and transforming landscapes

Dr. Christine Padoch
Matthew Calbraith Perry Curator
Institute of Economic Botany
The New York Botanical Garden

According to the United Nations, in 2007, for the first time in history, more than half the world's population is residing in urban places. Cities throughout Amazonia have been growing rapidly for several decades and over the last 25 years the majority of Amazonians have come to live in urban areas. Patterns of urbanization in Amazonia are, however, diverse and complex and the impacts of urbanization on resource use and on terrestrial and aquatic environments are similarly complicated and variable. The paper discusses a number of environmental changes linked to urbanization in Amazonia. Three cases are highlighted: (1) the increase in production of fast-growing timbers for cheap construction materials; (2) the boom in açai (Euterpe oleraceae) production and consumption, and (3) the increasing prevalence of fires in peri-urban forest zones..

Thursday, July 19, 18:00

Social, Economic and Political Drivers of Land Use Change in Borneo: Effects on Rural Livelihoods, Carbon Emissions and Biodiversity

Dra. Lisa M. Curran
Professor & John Musser Director, Tropical Resources Institute
Yale School of Forestry & Environmental Studies
Yale University

A major challenge of sustainability science involves assessing the resilience of human-environmental systems that are experiencing multiple natural and anthropogenic perturbations that vary in rate, extent and intensity. Moreover, these ecosystems display non-linear dynamics with both positive and negative feedbacks and potential thresholds of ecosystem function at local, regional and even global scales. Here I present a case study from tropical forests in Indonesian Borneo that documents a major perturbation to human-environmental systems in this region ¬ large scale and intensive land clearing for agribusiness (e.g., oil palm plantations). First, I evaluate the macro- and microeconomic and political drivers of oil palm expansion with global demand for edible oils and biofuel. Then I assess the effects of these land use changes on carbon emissions, biodiversity and forest dependent livelihoods in both a local district and across the island of Borneo. Then I explore the institutional incentives and disincentives for a diversity of agents involved or affected by such practices: firms and conglomerates, district officials and national agencies and rural resident villagers and peri-urban landless poor. Governmental policies have not incorporated the opportunity costs of plantation expansion on land use, ecosystem goods and services or the vulnerability of rural poor to global market dynamics. Civil society requires this diverse information with potential scenarios to participate effectively in realistic assessments of such land use decisions. Issues of land tenure, social and environmental justice, accountability and transparency of governance are critical to evaluate private sector behavior and long-term regional sustainability of this agribusiness sector. keywords deforestation, fire, agribusiness, ecosystem goods and services

SYMPOSIA

#1 Part I: The influence of human demography and agriculture on natural systems in the Neotropics

MONDAY JULY 16
Room 1: Teatro José Ruben Romero
Bulding: Teatro José Ruben Romero (Auditorium)

Organized by:

- T. Mitchell Aide, Department of Biology, University of Puerto Rico
- H. Ricardo Grau, Lab. de Investigaciones Ecológicas de las Yungas. Universidad Nacional de Tucumán

Latin America is experiencing many rapid changes. Although the population is expected to increase to 750 million by 2050, fertility has dropped rapidly in many countries during the last decade. Land-use changes show two general, but opposite trends: agriculture expansion and deforestation in lowlands and land abandonment in marginal areas, usually in mountainous regions. These changes are related to agriculture concentration in the most productive lands and rural-urban migration. The complexities of these processes present opportunities and challenges for the conservation of the neotropical ecosystems. The goal of this symposium will be to present and discuss the ecological consequences of current trends in demography (rapidly increasing population, decreasing fertility, rural-urban migration) and land use (agriculture expansion, land use intensification, land abandonment) for neotropical ecosystems at a country or regional scale. We expect that possible products of this symposium could include an edited book, special issue in Biotropica, or a review article.

10:00 Evaluation of three cultural landscapes of Mexico

Maria de Jesús Ordóñez Díaz
Centro Regional de Investigaciones Multidisciplinarias-UNAM
Email: mordonez@servidor.unam.mx

The territory can be defined as the space inhabited by a cultural group, is the result of the social construction of human groups that create, define and give form through the appropriation, appraisal and alienation of the elements that conform it. In the territory mythical experiences live together in the space and time with the societies, is the space where norms and institutions are established and give sense of ownership to their inhabitants. The human groups own territories, transform and build landscapes as a results of the interaction of the human activities and the environment giving form to ecological, socioeconomic and cultural patterns. The landscapes are built historically, depending on the natural conditions and the cultural processes through the time, represent a fundamental component of the natural and cultural capital of the country. This job presents the evaluation of three cultural landscapes, located in three representative cultural and ecological regions of Mexico: temperate humid, temperate

subhumid, and tropical subhumid. It includes three states: Distrito Federal, Morelos and Quintana Roo. Three natural protected areas are evaluated, because land cover vegetation must be more conservated than areas out of the Mexican conservation system. The historic changes in the vegetation cover and land use is evaluated, through the construction of historic cartography, which is analyzed with a geographical information system. All this information is processed and analyzed from a historic perspective where the population dynamic of the human communities plays an important role to explain the processes that promote the stay or change of the vegetation cover . The land use and vegetation cover is related to the demographic and socioeconomic dynamic, the social perceptions that structure the local vision about the environmental transformations, their causes, consequences and alternatives.

Keywords: territory, cultural landscape, Distrito federal, Morelos, Quintana Roo

10:20 **A geographical analysis of causal factors of deforestation and CO2 emissions in the Lacandon rainforest, Mexico**

Miguel Castillo Santiago and **Ben de Jong**
El Colegio de la Frontera Sur
Email: mcastill@sclc.ecosur.mx

The objectives of this study were to analyze spatial patterns of deforestation and their respective CO2 emissions in the Lacandon rainforest, Mexico, related to spatially explicit socioeconomic variables. Deforestation rates and CO2 emissions associated with land cover change were estimated between 1975 and 2000 using land-cover geographical databases and biomass field data. Additionally this study examines the correlation between deforestation and potential causal factors of land cover change. To quantify deforestation, digitized land-cover maps elaborated during the 1970s and interpreted satellite imagery of 1996 and 2005 were employed. Geo-referenced national population and agricultural census, road maps and a digital elevation model were used to derive maps of accessibility, land tenure type, poverty and population density. These maps were overlaid on deforestation maps using GIS software and corresponding spatial patterns were analyzed. The analysis was made at two levels, the complete study area and selected sub-regions. Land cover change maps shown that most changes occurred due expansion of cattle rearing activities. In relation to causal factors, at regional level a weak negative correlation between poverty and deforestation was found, that is, higher poverty level corresponds to lower deforestation rates. As regards land tenure type, deforestation was higher in private property than ejido property. Accessibility variables and population density were better correlated with deforestation, than other variables.

Keywords: deforestation, land cover change, Lacandon rainforest, CO2 emissions

10:40 **Remittances, and forest recovery: rethinking conservation in the 21st century**

Susanna Hecht
School of Public Affairs/Urban Planning – UCLA

Globalization is often associated with deforestation, but less known are its impacts on forest recovery.. In this study we analyzed socio-economic data, detailed land use surveys and satellite imagery from early 1990s to the present to monitor changes in woody cover in El Salvador, a country deeply integrated into numerous global circuits. We documented roughly 20% increase in areas with more than 30% tree cover and a rise of about 7% in areas covered by more than 60% tree cover since early1990s, in spite of rural populations in excess of 250/km^2. Woodland resurgence reflected several processes: the impacts of the civil war, the retraction of the agricultural frontier, international migration and especially, its associated remittances. Agrarian reform, structural adjustment and emerging environmental ideas also played a role. This study adds new elements understanding the complexity of land use change in emerging globalized economies in the tropics and the potential conservation approaches for inhabited landscapes.

11:20 Population and land cover change in Guatemala

David Carr, Kathryn Grace, and **Jason Davis**
University of California Department of Geography
Email: carr@geog.ucsb.edu

The objective of this paper is to examine relations between rural population dynamics and land use/cover change in Guatemala. We hypothesize that rural population size, density, distribution, and structure will be related to land use/land cover change and tropical deforestation/reforestation at multiple spatial scales. Contemporary databases will be examined such as the 2002 Population Census, the 2003 Agricultural Census, and the Living Standards Measurement Study (LSMS) of Guatemala.

Keywords: population, land use/cover change, human dimensions of global change, agriculture, deforestation

11:40 The deforestation and reforestation of the Republic of Panama

S. Joseph Wright, [1] Mirna Samaniego[1] and **Helene C. Muller-Landau[2]**
[1]Smithsonian Tropical Research Institute
[2]University of Minnesota
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The Republic of Panama recently experienced a forest transition as forest cover increased by 0.36% per year between 1992 and 2000 after many decades of decline. Sub-national data reveal two distinctly different patterns of forest cover change among the 76 districts that comprise Panama, however. Economic opportunity appears to have driven a strong forest transition in districts that were already deforested when the first national survey of forest cover was completed in 1947. Here, the proportion of the population employed in agriculture decreased by an average of 31%, old-growth forest cover was limited and static, and natural secondary forest succession increased total forest cover by an average of 85%. In contrast, no forest transition was evident for districts that were largely forested in 1947. Here, the population employed in agriculture

also declined but by an average of just 20%, old-growth forest cover decreased by an average of 8%, and natural secondary forest succession increased so that total forest cover was virtually static. Population density and an index of human development explained 43% of the among-district variation in forest cover in 2000, with forest concentrated where populations are small and poor. Uneven economic growth has generated an unusual forest transition in Panama as old-growth forests continue to be lost from heavily forested areas and secondary forests increase sharply elsewhere.

Keywords: deforestation: reforestation: Panama: population growth: agriculture

12:00 Economic trends in colombian's agriculture and ecosystem transformations: geographical impact

Armando Sarmiento
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From the 1980s the pressure on Colombias low land ecosystems has increased. Economic policies and drivers produced an intensification of farming and mining activities in regions that previously showed low population densities. The discovery of new petroleum and coal deposits, the development of new transport infrastructure projects, and the growth of permanent cropping areas are the main causes. The main changes in land use in these regions occurred from forests and extensive grazing systems, towards citrus, oil palm and banana plantations. Also, due to the increase in illicit crop cultivation (mainly coca), deforestation in large marginal areas of the agricultural frontiers has increased. Recent policies promoting ethanol and bio-fuels will increase in the near future the demand for crop areas of sugar cane and oil palm; there will also be an expansion of corn crop area due to price increases triggered by ethanol production in the US. In demographic terms, these trends are characterized by rural population decreases in large areas of Andean region and a dynamic population increase in the Eastern lowlands and the northern plains of the Caribbean region of the country. This population growth in the lowlands is characterized by sprouting of new settlements to house workers for new plantations is being located, creating additional pressures for new infrastructure and facilities. Current land use planning policies lack suitable instruments to respond to these new dynamics and environmental challenges.

Keywords: Demographic trends, Economic aperture, Land use change

2 Primates at Risk: Conservation Concerns and Anthropogenic Landscapes

MONDAY JULY 16
Room 2: Conservatorio de las Rosas (Auditorium)
Building: Conservatorio de las Rosas

Organized by:

- Kevina Vulinec, Department of Agriculture and Natural Resources, Delaware State University
- Kathryn E. Stoner, Centro de Investigaciones en Ecosistemas, Universidad Nacional Autónoma de México

In this symposium we present papers on the current knowledge of primates and anthropogenic disruption of the landscape. We concentrate on landscapes in the Americas. Of particular interest is how primates are reacting in terms of populations and behavior to different land use patterns over landscape levels. This group of papers explores current research in primate conservation in reference to human land use patterns, including that by indigenous people. These patterns include fragmentation, but also land use as different management regimes by local and indigenous people. These land practices include hunting, agriculture, and development.

10:00 Fear and loathing in the rainforest: hunting and primate behavior in the Americas

Kevina Vulinec and **David Mellow**
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Hunting affects primate behavior and population size by the direct killing of adults and through indirect effects on behavior. Certain primates, including the adaptable *Alouatta* spp. in hunted areas have smaller troop sizes, evince avoidance behavior, and the presence of humans alone may disrupt normal activities. Other primates in the same areas, particularly smaller, less hunted species, react less fearfully to the presence of humans. We summarize over 10 years of primate surveys from areas with differing hunting pressure in the Brazilian Amazon and discuss the effect of hunting on behavior, troop size, and density.

Keywords: Primates; hunting; behavior; populations

10:20 Patterns of distribution and persistence in a degraded landscape: a primate community in the Brazilian Amazon

Sarah A. Boyle[1], Kellen A. Gilbert[2], , Wilson R. Spironello, Alaercio Marajó dos Réis[3], Osmaildo Ferreira da Silva[3], Waldete Castro Lourenço[3] and **Lívia Rodrigues da Silva[3]**

[1]Arizona State University, Tempe, Arizona, USA
[2]Southeastern Louisiana University, Hammond, Louisiana, USA
[3]Instituto Nacional de Pesquisas da Amazonia, Manaus, Brazil
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We present the findings of more than two decades of primate census data in nine forest fragments in upland *terra firme* forest in central Amazonia. Forest fragments varied in size and distance to closest forested area, and the condition of the surrounding agricultural matrix ranged from pasture to high secondary growth forest. Furthermore, the six primates species present in the study area varied in body size, home range requirements, and diet. We found differences in primate species composition and distribution across the fragmented landscape, and the persistence of the species in the fragments varied throughout the two decades. While some species (*Alouatta seniculus*) fared well in the fragmented landscape and were present in fragments as small as 1ha, other species (*Ateles paniscus*) were rarely present in the fragments. We discuss the implications of these ecological and behavioral differences for primate conservation in agricultural areas.

Keywords: primates, forest fragmentation, conservation

10:40 Presence of black howler monkeys (*Alouatta pigra)* and regeneration in tropical rain forest fragments in the Lacandon region, Chiapas, Mexico

Ana Marie González di Pierro, J ulieta Benítez-Malvido, and **Kathryn E. Stoner**
Centro de Investigaciones en Ecosistemas, Universidad Nacional Autónoma de México
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Primates are known to be important seed dispersers for many tropical plant species. Although Howler monkeys (*Alouatta* spp.) are classified as folivores based on their annual diet, it has been well documented that they consume a great variety of fruits. Because of their dietary plasticity and flexible social structure, howler monkeys are often found in perturbed habitats, making them a potentially important factor in the regeneration of forest fragments. We evaluate the importance of *Alouatta pigra* in seed dispersal and fragment regeneration by documenting species of plants dispersed by howlers and determining the effect of seed ingestion on germination. Furthermore we compare tree species richness, seedling richness, and seedling establishment in continuous forest, fragments with monkeys, and fragments without monkeys. The study was conducted in the tropical wet forest of Lacandona region, Chiapas, in southeastern Mexico. Howler monkeys dispersed seeds from 24 species in the continuous forest and 16 in forest fragments. Ingestion had a positive effect on germination in three (*Dialium guianensis*, *Garcinia intermedia* and *Tetracera* sp.) of the six species evaluated. No significant differences were observed in tree species richness among fragments with monkeys, without monkeys and continuous forest. Nevertheless, a significantly lower importance value of species dispersed by howlers was found in fragments without monkeys. Seedling richness and seedling establishment was greater in fragments with howlers than in those without. Overall, the presence of howler monkeys appears to

positively influence forest regeneration in tropical rain forest fragments in the Lancandona region.

Keywords: Howler monkey, seed dispersal, germination, regeneration forest

11:20 The influence of large tree density on Howler Monkey (*Alouatta palliata mexicana*) presence in very small rainforest fragments

Arroyo-Rodriguez Victor(1), Mandujano Salvador(1), Benitez-Malvido Julieta(2),
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The populations of the Mexican mantled howler monkey (*Alouatta palliata mexicana*) in the Los Tuxtlas region, Mexico, have declined drastically due to habitat loss and fragmentation. Nevertheless, several troops still inhabit very small and isolated rainforest fragments. We identified the main vegetation attributes that can favour the presence of howlers within 18 small (< 10-ha) fragments that did not differ significantly in size, shape and isolation (nine occupied and nine unoccupied by howlers). We found that habitat quality (i.e., food resources and vegetation structure) affected howler incidence in small fragments. Particularly, the occupied fragments showed greater density of big trees (DBH > 60 cm), greater total basal area, greater basal area of persistent tree species and greater basal area of top food species than the unoccupied fragments; suggesting that even for small fragments the loss of big trees and particularly the decrease in size class of the top food species can negatively affect howler distribution in highly fragmented landscapes. These findings could be used to establish foreground conservation areas for this critically endangered subspecies in fragmented landscapes of Los Tuxtlas.

keywords: fragmentation, habitat quality, Los Tuxtlas, Mexican mantled howler monkeys, Mexico

11:40 Spider monkeys (*Ateles geoffroyi*) in small reserves: can mutualistic interactions between large monkeys and large seeded plants be maintained in the Osa Peninsula, southwestern Costa Rica?

Pablo Riba Hernández[1] and **Kathryn E. Stoner[2]**
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Spider Monkeys (*Ateles*) are the largest Neotropical specialized frugivores capable of dispersing large seeds. Due to anthropogenic actions, the Osa Peninsula in southwestern Costa Rica has been fragmented into small islands with only a few protected areas. It is unknown to what extent mutualistic interactions, such as seed dispersal of large seeds by monkeys, are maintained within these small protected reserves. We evaluate the status of *Ateles geoffroyi* as seed dispersers in the tropical rainforest at Punta Rio Claro Wildlife Refuge (500 ha; 90% mature forest). If this small

reserve is successful in maintaining the mutualistic interactions offered by *Ateles* we expected: 1) large-seeded plants will be included in their diet, 2) most fruits consumed will result in seed dispersal, 3) foraging will occur mainly in mature forest, and 4) monkeys will be present year around within the reserve. *Ateles* consumed fruits from 52 of the 70 tree species reported for the reserve. Their diet included 30% large-seeded species, with all species being swallowed and dispersed. Large-seeded tree species were the most important in their diet. Approximately 90 % of their foraging time occurred in primary forest. Although it appears as if the mutualistic interaction of seed dispersal by *Ateles* is maintained within this small reserve, monkeys were not found year around, being absent in the months coinciding with the lowest fruit availability. These results suggest that 500 ha may not be big enough to sustain local populations of *Ateles* within the region. Their absence within small fragments, even for part of the year, may have consequences for the regeneration of large-seeded plants and ultimately effect forest structure and composition. We suggest that conservation efforts within the region focus on preserving larger fragments of mature forest to ensure the maintenance of mutualisitc interactions between large-seeded plants and their dispersers.

Keywords: frugivory, mutualism, fragmentation, primates

12:00 Human dimension of primate conservation issues in tropical countries and conservation value of some current, traditional and alternative land management practices from Mesoamerica

Alejandro Estrada, Genoveva Trejo and **Cristina Jasso**
Estación de Biología Tropical Los Tuxtlas, Instituto de Biología, Universidad Nacional Autónoma de México
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Pressures for land use have been pointed out as the major cause of tropical rain forest loss and fragmentation throughout the world, and a major cause of increases in rates of species extinction in recent decades. The high primate diversity found in the Neotropics, Africa and Asia makes these regions one of the world's greatest conservation challenges. In this paper we examine several aspects of the human dimension of the conservation problem of primates and their habitats in these three regions. We specifically review available data on human population growth trends, levels of poverty, major land use patterns as they relate to food production, and deforestation rates and trends. We additionally inspect the PrimateLit database to generally assess the richness of our data banks on the basic biology, ecology and behavior of primate taxa for the three geographic regions of interest. We further examine regional conservation initiatives and their possible impact upon the persistence of primate habitats. Finally, using a landscape approach, we look at some current, traditional and alternative land management practices in Mesoamerica as possible conservation scenarios of primate populations in human-modified landscapes.

Keywords: Mesoamerica, deforestation, poverty, traditional land-use, tropical rain forest conservation

3 Part I: The impact of plant phylogenies on tropical ecology and evolutionary studies

MONDAY JULY 16
Room 3: Cervantes Saavedra (Second Floor)
Building:Colegio Primitivo de San Nicolás de Hidalgo

Organized by:

- M. Alejandra Jaramillo, University of Missouri-Columbia, Div. Biological Sciences
- Lúcia G. Lohmann, Universidade de São Paulo, Instituto de Biociências, Departamento de Botânica

Ecology is the science that studies the interactions among organisms. Even though these studies have traditionally not taken historical factors into account, it is now clear that phylogenies add a great deal when integrated with ecological studies. For example, phylogenies are key for the identification of homologies and homoplasies. While homologies give us an opportunity to study possible evolutionary limitations of ecological processes, homoplasies allow us to test hypotheses about diversification of organisms through the comparative method. This method relates independent evolutionary changes in traits with environmental factors and/or morphological traits which, in turn, allow us to better understand the processes behind diversification. Ecological studies can benefit from phylogenies in various ways, namely through studies of (1) the evolution of ecological traits; (2) ecological correlates of diversity; and (3) studies of the phylogenetic structure of communities. The aim of this symposium is to highlight the importance of phylogenies to ecological research as well as to stimulate discussion on ecological questions from a phylogenetic standpoint. We will provide a broad perspective of the interface between phylogenetics, ecology and evolution, and introduce the audience to the large realm of research opportunities to be explored. The invited speakers will cover a large range of topics and environments, from community ecology to coevolution of plants and insects, and from the lowland Amazonian forests to the upland montane Páramos.

10:00 Phylogenetic structure of communities and traits in tropical woody plants

Jerome Chave[1], Claire Suchet[1] and **Hans ter Steege [2]**
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I will use phylogenetic reconstructions including a large number of neotropical tree and liana genera to measure (1) the amount and variation of phylogenetic diversity in trees across Amazonian forests, (2) the phylogenetic conservatism in a key plant trait correlated with successional status, wood density, for a large number of neotropical tree and liana species. I will then discuss a possible relationship between phylogenetic and 'successional' diversity.

Keywords: phylogenetic diversity, wood density

10:20 Using phylogenies to integrate ecological and evolutionary studies of trait tradeoffs in Amazonian plants

Paul Fine[1], Italo Mesones [2] and **Christopher Baraloto [3]**
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[2]Universidad Nacional de la Amazonia Peruana
[3]University of Florida
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The phylogenetic structure of communities can provide insight into the processes controlling species distributions, including the evolution of traits that confer advantages in one habitat at the expense of a second habitat. Two different approaches have been used to evaluate the phylogenetic basis of these trait tradeoffs among different plant communities. One method correlates phylogenetic distances with species trait data and/or environmental data to test for patterns of evolutionary convergence in traits and/or environmental niche specialization. A second method ignores phylogenetic branch lengths. Instead, it contrasts multiple pairs of sister taxa that are habitat specialists, and conducts reciprocal transplant experiments to test for differential performance and phenotypic expression across habitats. We review the strengths and limitations of these two approaches using data for twenty species from the genus Protium (Burseraceae) that represent edaphic specialists from white-sand and clay terra firme forests in the Amazon basin. We examine evolutionary convergence and environmental filtering for traits related to growth, chemical and physical anti-herbivore defense and abiotic stress tolerance. We discuss ways to integrate phylogenetic distance data with observations and experiments to increase our understanding of trait tradeoffs and the mechanisms that underlie habitat specialization and speciation in Amazonian forests.

Keywords: community assembly; habitat specialization, growth-defense trade-off

10:40 Ecological diversification of Neotropical lianas (Bignonieae, Bignoniaceae): an integrative approach

Lucia Lohmann
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Lianas account for a third of leaf biomasss of tropical forests, contribute between 20-25% of the floristic diversity of the neotropics, and have important roles in ecosystem level functioning. Yet they have been little studied, and little is known concerning their systematics, evolution, ecology and biogeography. The tribe Bignonieae (Bignoniaceae) constitutes the most diverse and abundant clade of lianas in the neotropics. Apart from being important components of neotropical forests, members of Bignonieae are also known for their showy flowers associated with different pollinators, unusual extra-floral nectaries associated with herbivore defense, and diverse dispersal mechanisms. It is well established that evolution has produced large amounts of variation in ecological traits in Bignonieae but relatively little is known about the processes that underlie this diversity.

Comparative studies that integrate phylogenetics, divergence time estimates, and ecological data are helping to advance our knowledge in this area. Here I use a phylogenetic framework to test alternative hypotheses on the ecological diversification of this clade. Overall, key ecological traits have arisen several times during the diversification of the group and seem to reflect changes in the environment. Divergence time estimates suggest that the independent origins of ecological traits have occurred across a broad temporal scale, subsequently to changes in environmental conditions. This pattern is consistent with adaptation and suggests that a nested hierarchy of adaptations had a key role in the diversification of the group as a whole.

Keywords: Bignonieae, Bignoniaceae, Comparative Method, Diversification, Adaptation

11:20 Using plant phylogenies to understand patterns of dispersal assembly and niche conservation in the rain forests and seasonally dry forests of the Neotropics

R. Toby Pennington[1], Matt Lavin[2] and **Benjamin Torke[3]**
[1]Royal Botanic Garden Edinburgh
[2]Plant Sciences and Plant Pathology, Montana State University, Bozeman
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Email: t.pennington@rbge.org.uk

Phylogenies of plant groups with species found in diverse biomes tend to indicate that speciation events between biomes ("biome switching") is infrequent. Phylogenies of plant genera largely endemic to neotropical rain forests such as *Inga* and *Swartzia* (Leguminosae) show different biogeographic patterns in comparison to genera largely restricted to neotropical seasonally dry forests such as *Coursetia, Poissonia, Ateleia, Cyathostegia* (Leguminosae) and *Ruprechtia* (Polygonaceae). In the rain forest genera, phylogenetic geographic structure is low, especially in Amazonia, meaning sympatric species in a single region are not closely related. In contrast, in a single area of dry forest, congeneric species tend to be closely related and often form monophyletic groups. These patterns imply greater historical dispersal limitation between smaller, isolated areas of dry forests than within and between larger rain forest areas, suggesting different patterns of community assembly. This hypothesis of different dispersal assembly within biomes may be testable using the framework of phylogenetic community structure, because more sympatric congeners might be expected to be found in rain forests than dry forests. Furthermore, it may also be manifest in different patterns of relative species abundance because rare species may more often drift to middling abundance in dry forests that are less perturbed by immigration.

Keywords: Biogeography, community assembly, dispersal, ecological speciation, phylogenetic community structure

11:40 Modeling niche conservation with community phylogenetic distance as a response variable: a model selection approach to the identification of metacommunities

Ary Oliveira-Filho, Toby Pennington, Jay Rotella, and **Matt Lavin**

Molecular phylogenetic analysis of tropical legumes suggests that patchily distributed seasonally dry tropical forests form a dispersal limited metacommunity with a potentially high diversity generating capacity. This is inferred from strong patterns of geographic phylogenetic structure of narrowly distributed clades, each of which may comprise multiple allopatric species. To test this hypothesis, we take a model selection approach. Explanatory variables include geographic distances, from which dispersal limitation can be inferred, and environmental distances (e.g., measures of moisture, altitude, etc.), from which niche assembly can be inferred. Phylogenetic distance as a response variable provides insights into the degree of niche conservation. In contrast, community distance (e.g., Sorensen) as a response provides insights into the relative contribution of dispersal versus niche assembly. A metacommunity may have dispersal limited local communities because of niche assembly. If speciation events are equally likely to encompass all of the local variation within a metacommunity, dispersal limitation will not be evident at the clade level. A simple example that illustrates this approach involves inventory data taken from deciduous and semidecidous forest in Brazil. Key Words: phylogenetic distance, biodiversity, dispersal limitation, niche assembly

12:00 **Neither trees nor herbs: the evolution of giant rosettes and other adaptations in the Agavaceae family**

Luis E. Eguiarte[1], Ileana Nuri Flores Abreu[1], Valeria Souza[1], Sara V. Good-Avila[2] and **Abisai Garcia-Mendoza[3]**
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[2]Acadia University, Canada
[3]Instituto de Biologia, Universidad Nacional Autonoma de Mexico (UNAM)
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In the Agave L. family (Agavaceae, Endlicher) we recognize nine genera and ca. of 300 plant species, all native to the Americas. Most of the species and all the genera are found in Mexico. In particular here we analyze the genus *Agave* sensu lato, including *Agave*, Manfreda Salisb., *Polianthes* L. and *Prochnyanthes* Watson, representing at least 208 species that include key-stone species both because of its ecological dominance and the large amounts of resources produced by its massive, suicide flowering. *Agave* is also of huge economic value to Mexico because the plants are the raw material for the production of tequila and mezcal. We explore the adaptive radiation in the genus *Agave sensu lato* using recently obtained sequences of non-coding chloroplast regions (matK-trnK,trnL-trnF,trnD-trnT) for a set of 49 species of the family, using a Yucca-like fossil age and other new calibration dates. The main pollinator of *Agave* is the nectarivorous bat Leptonycteris curasoae and ecological observations suggest it has had a critical role in the evolution of the semelparous (suicide) reproduction in Agave. We analyze the hypothesis of a *Leptonycteris-Agave* coevolution using molecular clocks by dating the origin of both genera. We also evaluate if there is a correlation between the different reproductive strategies and the increase in speciation rate in the Agavaceae, as well as the evolution of *Agave* geographic ranges using statistical tests with a likelihood framework.

Keywords: *Agave, Leptonycteris*, coevolution, molecular clock, speciation rate

4 Ecology of insect x plant interactions in the tropics

MONDAY JULY 16
Room 4: Sala Rectores (Second Floor)
Building: Centro Cultural Universitario

Organized by:

- Carlos Roberto Fonseca, UNISINOS, Brazil
- Flávia Nogueira de Sá, Universidade Federal do Rio Grande do Sul, Depto. Ecología – Inst. Biociências

The interaction between herbivorous insects and their host plants has intrigued researchers for a long time. Given that it deals with two of the most diverse lineages of eukaryotes, many approaches have been used to document and evaluate this phenomenon. In this symposium, results of recent work conducted in the tropics will be presented aiming to provide the opportunity to ecologists that are interested in different aspects of insect x plant interactions to discuss new ideas. Both sides of the interaction, from the plant point of view and from the insect point of view will be considered. The first presentations will present new ideas about the ecology of communities of herbivorous insects, especially dealing with the spatial and temporal abundance of these animals on their hosts. The second part of the symposium will consider the impacts of insects on the plants - from the individual to the community levels. Finally, an application of recent knowledge on this type of interaction will be presented to provide a discussion about the future of these studies and, more importantly, on the conservation of insects and plants.

10:00 The impact of specialized herbivores on plant community structure

Judith Becerra, University of Arizona
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Coevolutionary theory proposes that the diversity of chemical structures found in plants is, in large part, the result of selection by herbivores. Because herbivores often feed on chemically similar plants, they should impose pressures on plants to become chemically different or bias community assembly toward chemical divergence. Using a coevolved interaction between a group of chrysomelid beetles and their host plants I tested whether coexisting plant species in communities of the Mexican tropical dry forest tend to be chemically more dissimilar than random. Samples of leaves of 57 Bursera species were collected from live plants in natural populations in Mexico and immediately extracted in dichloromethane. Chemical extracts were analyzed using gas-chromatography mass spectrometry. Results show that some of the communities studied are chemically overdispersed and that this phenomenon is related to the tightness of the interaction between plants and herbivores and the spatial scale at which these organisms interact. As coevolutionary specialization with herbivores increases and spatial scale decreases, communities tend to be more chemically dissimilar. At fairly local scales and where herbivores have tight, one to one interactions with plants, communities have a strong

pattern of chemical disparity.

keywords: Herbivory, coevolution, chemistry, community structure, tropical dry forest

10:20 Latitudinal changes on herbivory: comparison between the distribution extremes of a Chilean endemic tree

Ek del-Val[1] and Juan Armesto[2]
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Herbivory is known to be an important selective force for plants. This pressure is differential depending on herbivore abundance and it is expected to change throughout a plants latitudinal range. However few studies have documented latitudinal changes on plant-herbivore interactions. This investigation studied the consequences of vertebrate and invertebrate herbivory on seedlings of an endemic Chilean tree (Aextoxicon punctatum) at the extremes of its distribution (separated by ~3000 km). A mammal exclusion experiment was set up and seedlings were surveyed for invertebrate and vertebrate herbivory for 16 months in both study sites. Aextoxicon punctatum seedlings were transplanted into the field sites (512 in the northern and 416 in the southern sites), and half of them were situated into the exclusion (fenced) plots and half in the controls. Seedling survival was greater in the southern (83%) compared to the northern site (56%, $p<0.05$). Excluding mammal herbivores increased plant survival by ~30% in both study sites. In contrast, invertebrate herbivory was greater at the southern site (8.5% vs 5%, $p<0.05$). Results are discussed on the context of tree regeneration dynamics and the importance of habitat integrity for plant-herbivore interactions.

keywords: herbivory,latitudinal gradient,tree regeneration

10:40 The global decline of insect herbivores in biodiversity hotspots

Carlos Roberto Fonseca
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Insect herbivores depend on their food plants for survival; therefore, their geographic distribution is necessarily constrained by the distribution of their hosts. In the case of monophagous insects this is even more crucial, since their evolutionary history made each one of them rely on a single plant species. Since biodiversity hotspots have been threatened worldwide by habitat loss, the geographic area of half the vascular plants has been greatly reduced. Here, based on species-area equations for insect herbivores, one is able to estimate that 213 to 547 thousand monophagous species can be now extinct or are in the verge of extinction in the 34 recognized biodiversity hotspots. Estimates of the richness of monophagous species and the number of expected extinctions allow biodiversity hotspots to be ranked in terms of insect conservation priority. One

recognizes that there is an opportunity for the civil society to actively engage biodiversity conservation by improving habitat quality for insect use in private lands. Only this kind of commitment can help us halt this global mass extinction.

keywords: Extinction, Insect herbivores, Biodiversity hotspots, Conservation

11:20 Are there-top-down effects in Neotropical savannas? Quantifying the impacts of a keystone herbivore (*Atta* spp.)

Emilio M. Bruna[1], Heraldo L. Vasconcelos[2], Alan Nilo da Costa[2], Fabiane M. Mundim[2], Alana Vaz Ferreira[2], and Ernane H. M.Vieira Neto[2]

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Plant communities in Paleotropical savannas are regulated by a combination of pervasive bottom-up and topdown effects. However, the paucity of ungulates and other large herbivores in Neotropical savannas has led to speculation that these communities are primarily structured by physical factors such as fire, precipitation and soil chemistry. While the importance of abiotic drivers in Neotropical savannas is indisputable, the available evidence suggests asserting their primacy is premature. Empirical studies quantifying the impacts of herbivores in Neotropical savannas such as Brazils Cerrado are extremely rare, making it difficult to assess the relative importance of top-down and bottom-up effects. Furthermore, although mammalian herbivores are indeed less abundant, Neotropical savannas contain a diverse community of insect herbivores. This community includes species such as leaf-cutter ants (*Atta* spp.), which are conspicuous throughout much of tropical and subtropical America and are the dominant herbivore in many locations. Only by evaluating the impacts of consumers can we elucidate the relative importance of factors influencing plant population and community structure. Using direct measurements of herbivory, coupled with estimates of plant productivity and ant colony density, we found that leaf-cutter ants (Atta spp.) consume 13-17% of the foliar biomass produced annually by woody plants in a Neotropical savanna. This level of herbivory is comparable to the proportion of annual net foliage production consumed in African savannas by several ungulate species, and more than double the net foliage production consumed in many terrestrial ecosystems. Our experiments also indicate Atta can exert strong impacts on plant phenology and are dominant seed predators. We hypothesize that this intense consumption of biomass and seeds by Atta will have important ecological consequences for the Cerrado ecosystem; because
leaf-cutter abundance increases in fragmented or degraded habitats these effects are likely to be exacerbated as anthropogenic pressure in this biodiversity hotspot increases.

keywords: Atta laevigata, biomass consumption, Brazil, Cerrado, herbivory, phenology

#1 Part II: The influence of human demography and agriculture on natural systems in the Neotropics

MONDAY JULY 16
Room 1: Teatro José Ruben Romero
Bulding: Teatro José Ruben Romero (Auditorium)

Organized by:

- T. Mitchell Aide, Department of Biology, University of Puerto Rico
- H. Ricardo Grau, Lab. de Investigaciones Ecológicas de las Yungas. Universidad Nacional de Tucumán

14:00 Land-use and land-cover trends in the metropolitan region of Florianopolis, Santa Catarina state, southern Brazil

Sandra Baptista
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Over the past half century agricultural modernization, industrialization and urban expansion have transformed the livelihoods and landscapes of southern Brazil. In the case of Santa Catarina, state-wide multivariate analyses of Brazilian agricultural census data for the 25-year period from 1970 to 1995 indicate that a transition from a period of net forest losses to one of net forest gains occurred on privately-owned rural land between 1975 and 1980. In eastern Santa Catarina, it appears that this forest transition resulted from the expansion of planted exotic pine forests in mountainous inland areas located near urbanizing coastal municipalities. Furthermore, in recent decades environmental legislation has promoted some degree of ecosystem regeneration and biodiversity conservation including the spontaneous regrowth of native Atlantic forests. Meanwhile, sprawl development in coastal municipalities has accelerated, converting formerly agricultural lands into residential and commercial subdivisions and increasing demand for forest products. In areas surrounding Florianopolis, the capital city of Santa Catarina state, the proportion of rural-to-urban land has diminished while the service sector has expanded. Presenting demographic, agricultural and conservation data for the Florianopolis metropolitan region, this paper describes the landscape transformations that have taken place in twenty-two municipalities encompassing about 710 000 ha. While legal measures intended to protect native Atlantic Forest ecosystems throughout the region combined with the establishment of exotic tree plantations in higher altitude municipalities have contributed to forest cover gains, the pressures of coastal urbanization threaten biological diversity and prevent forest recovery in areas undergoing rapid real estate development.

Keywords: forests, urbanization, Brazil, Santa Catarina, Florianopolis

14:20 Movement of population and investment in Brazilian Amazonia as factors in deforestation

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The effect of population on deforestation is very flexible because cattle ranching (the main use of deforested land in Brazilian Amazonia) is an activity through which a tiny population of humans can have a tremendous impact on the forest. The key question is the type of actor that is moving into an area of forest. This migration has much more impact on deforestation than does the vegetative growth of any segment of the population. Types of actors cover a full range in terms of wealth, legality and the intensive or extensive nature of their activities. Poor landless migrants arrive in the region from source areas such as Maranhão; one component of this migration is seeking free land (usually coming as whole families), while another component (composed of single men or men who arrive without their families) seeks either employment as laborers in or engages in other activities such as gold mining. Movements within the region are now opening frontiers with a large role from the children of settlers who had settled in government colonization areas, such as the migrants from Rondônia who are opening areas in Apuí and Maputi in southern Amazonas. More capitalized small farmers from other regions arrive seeking land purchase, especially those who have sold small farms in southern Brazil to invest in larger parcels in Amazonia. A form of movement with significant consequences is represented by groups of large illegal landgrabbers (*grileiros*). Movement of *grileiros* from the BR-163 Highway in Pará to the Apuí area in Amazonas is a type of event that can result in large areas of deforestation even though the number of people is small. The same is true of drug traffickers and money launderers, such as those in the Terra do Meio between the Xingu River and the BR-163 Highway. Sawmill owners represent another migratory group with great impact on the forest. In the future major movements of are expected as a result of two planned dams on the Madeira River, scheduled for completion in 2011 and 2012. Each dam will employ 20,000 workers in the construction, and, at the end of the construction, this contingent of unemployed men is likely to move to central Amazonia and to Roraima if the BR-319 Highway from Porto Velho to Manaus is reconstructed as planned.

Keywords: Deforestation, Population, Migration, Rainforest, Ranching

14:40 Land-use change in Bolivia: who, where, when, and how much?

Tim Killen
Conservation International

The history of land-use change and migration in eastern Bolivia is documented based on five sequential epochs: pre 1976, 1976 – 1986, 1986 – 1991, 1991 – 2001 and 2001 – 2004. The study includes all land cover types situated below the natural montane tree line (~3000 m) and includes forest, savanna, scrubland, and seasonal wetlands, as well as second growth forest, pasture, cropland, and secondary forest. Rates of land use change have grown from approximately 45,000 ha yr^{-1} in the 1960s to more than 290,000 ha yr^{-1} in the last epoch. Land-use change was quantified for ten distinct social actors with shared cultural traditions and production systems. Mechanized farmers from Santa Cruz and Andean colonists were responsible for most land-use change in the 1960s and 70s (19,177 and 7,919 ha yr^{-1} respectively). Deforestation by Andean colonists grew to be twice that of other groups during the late 70s and 80s (41,832 ha yr^{-1}), but

experienced a decline in the 90s (29,917 ha yr^{-1}) to increased again in the most recent epoch (61,663 ha yr^{-1}). Japanese colonists have shown low but constant rates of land-use change over four decades (2500 – 3880 ha yr^{-1}), while Mennonite colonies have experienced steady increases in land-use change that tracks their migration into the country (1094 to 16,550 ha yr^{-1}). In the last 15 years, land-use change by a new group, ago-industrialists specializing in soy and other oil crops became important (49,536 ha yr^{-1}), while cattle ranching based on cultivated pastures surpassed all other groups (~ 70,000 ha yr^{-1}).

15:20 Thirty years of human demography and land-use change in the Atlantic Forest of Misiones, Argentina: a test of forest transition models

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For many years, tropical and subtropical forests have been deforested for agriculture, grazing, and timber extraction. Nevertheless in the last decade, several publications have suggested that some regions of Latin America are showing a process of forest transition. This theory predicts that industrialization and urbanization will lead to the abandonment of marginal agriculture lands, and the recovery of natural systems (e.g. forests). However, there are many ecological, economic, and social factors that could act as barriers to ecosystem recovery. To test these scenarios, we analyzed the socioeconomic and land-use changes during the last 30 years, at provincial and department level in the province of Misiones, Argentina. We described the changes in the distribution of urban and rural populations based on the National Population Censuses from 1970, 1980, 1991, and 2001. Land-use change was based on a supervised analysis of four mosaics of MSS and Landsat TM satellite images from 1973, 1979, 1989 and 2006. The results show that although the change in the rural population varied greatly among the different departments, at the provincial level there has been a dramatic increase in the urban population. The major landuse changes between 1973 and 2006 have been an increase of 302 000 ha of mono-specific plantations (mainly Pinus and Eucalyptus), and a loss of 720 000 ha of natural forests. Misiones possesses the largest remnant of continuous Atlantic Forest, which is famous for its high level of biodiversity and endemism, but much of this forest is now mono-specific plantations. Although demographic changes in Misiones have been similar to other regions (i.e. rural-urban migration) and there has been an overall increase in forest cover, forest transition in this case is leading to plantations with much lower ecology value.

Keywords: demography, land-use change, forest transition, Atlantic Forest

15:40 Agriculture adjustment, population urbanization and nature conservation in NW Argentina

Ricardo Grau[1], Ignacio Gasparri[1], Alfredo Grau[1], Mariano Morales[2], Julieta Carilla[2], Ezequiel Araoz[2] and Andrea Izquierdo[3]
[1]Universidad Nacional de Tucuman

[2]CONICET
[3]CEIBA

We analyzed government statistics and published case studies to assess the trends in human demography and land use change during the last 50 years in NW Argentina, a subtropical region (>50 million ha), which includes different life zones: dry forests (Chaco), montane humid forests (Yungas), high elevation grasslands and shrublands (Puna), and middle elevation desserts (Monte). And, to assess the impacts of these changes on nature conservation. Agriculture intensified and expanded in mesic lowland ecosytems and middle elevation irrigated desserts, favored by international demand for commodity products (soybean, sugar, wine). In these areas, population grew fast and became concentrated in urban centers. In contrast, in the different mountain ecosystems, marginal agriculture and extensive grazing decreased in association to a reduction in rural population. This process favored the recovery of different forest types and the expansion of population of once threatened large mammals (e.g. Vicugnas in the Puna). These opportunities for ecosystem recovery, however, where limited by the existence of different stable and low diversity plant communtities. For example in Yungas ecosystems, peri-urban secondary forests are often dominated by highly resilient monodominant exotic tree stands; and fire-maintained degraded grasslands are not invaded by trees even when grazing pressure decreases. Dry forests combine both expansion of modern agriculture and reduction in extensive grazing over non-deforested areas. Balancing these two processes is the key to ensure the conservation of the Chaco, one of the largest continuous remaining neotropical dry forest ecosystems. Overall, this analysis indicates that ecosystem recovery associated to agriculture adjustment to the most productive soils allows growing food production in association to increasing regional opportunities for nature conservation. However, complex interactions between social and natural systems need to be considered to take advantage of these opportunities and to minimize the threats associated to rapid land use change.

Keywords: agriculture adjustment, rural-urban migration, dry forests, montane forests, Argentina

16:00 The influence of human demography and agriculture on natural systems in the Neotropics

Jane Earley
Biofuels – WWF-US

The expansion of agricultural production to meet biofuels development poses a number of questions for tropical ecosystems, among them whether increased production of current biofuels feedstocks is consistent with principles of sustainable development. Current indications are that a number of proposed biofuels feedstocks can exacerbate water scarcity/shortages and contribute to effluent streams that will increase rates of bioaccumulation in soil and sediment as well as in marine organisms. Large-scale development can also pose a threat to terrestrial and marine biodiversity through habitat conversion. What is the prognosis for such development in the Latin American and Caribbean region, and what processes have been initiated to address the environmental and social issues that they raise? This presentation will propose a cross-commodity framework that will allow comparisons of the net impact of different agricultural throughput used for biofuel production and suggest specific ways that performance can be improved for each crop.

#5 Landscape ecology of bats: from population to community

MONDAY JULY 16
Room 2: Conservatorio de las Rosas (Auditorium)
Building: Conservatorio de las Rosas

Organized by:

- Mickaël Henry, Centro de Investigaciones en Ecosistemas, Universidad Nacional Autónoma de México
- Kathryn E. Stoner Centro de Investigaciones en Ecosistemas, Universidad Nacional Autónoma de México

The objective of the symposium is to gather the most recent information on bat population and community responses to habitat loss and fragmentation, and, more generally to landscape heterogeneity in the tropics. Recent studies have shown that not only the type of habitat influences the local structure of bat assemblages, but also the type and spatial arrangement of the surrounding habitats. This symposium aims at (i) providing examples of studies documenting the effect of landscape heterogeneity on bat diversity patterns, and (ii) discussing methodological aspects about how to measure landscape connectivity and to apply landscape concepts and analyses to bat ecology.

14:00 Modeling the distribution of bats in heterogeneous landscapes: toward a definition of functional connectivity

Mickaël Henry[1], Jean-Marc Pons[2] and **Jean-François Cosson[3]**
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[2]Departement Systematique et Evolution, Muséum National d'Histoire Naturelle, Paris, France
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Landscape connectivity may greatly influence the distribution of animals when it alters their movements and their ability to reach food patches. Depending on their foraging behavior, organisms may or may not adapt to anthropogenic changes in landscape connectivity and may eventually undergo local extinctions. Recent studies underlined the need to use indicators of functional landscape connectivity based on the behavior and movement abilities of studied animals to better link landscape structure to ecological processes in disturbed and fragmented areas. The objectives of this study were (i) to elaborate an index of functional connectivity for *Rhinophylla pumilio*, a Neotropical understory frugivorous bat, and (ii) to use this index to investigate the possible mechanisms controlling its distribution and sustainability in a fragmented landscape. We pursued a 10- year bat mist-net survey, coupled to local estimates of food availability, in a mature forest of French Guiana that was recently fragmented by the completion of a reservoir lake. The 18 sampling sites range from undisturbed continuous forest sites to small remote forest fragments. A connectivity value, based on radiotracking surveys, was

attributed to each site. Connectivity measures mean forest cover within neighboring landscape units, weighted by the probability bats would use them, as estimated by frequency distribution of flight distance data. The abundance of *R. pumilio* was positively correlated with landscape connectivity and not correlated with local food availability. In spite of its high mobility, *R. pumilio* apparently failed to exploit a food resource that is distributed patchily over a low-connective habitat because its foraging movements are not well adapted to habitat disruptions.

Keywords: Landscape ecology, forest fragmentation, phyllostomid bats, functional connectivity

14:20 Community-level responses of Neotropical bats to habitat fragmentation: land-bridge islands in Gatun Lake, Panama, as a model system

Christoph F. J. Meyer [1] and **Elisabeth K. V. Kalko**[1,2]
[1]Department of Experimental Ecology, University of Ulm
[2]Smithsonian Tropical Research Institute
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Many effects of habitat fragmentation on diverse assemblages of tropical vertebrates are poorly understood, particularly with respect to the mechanisms underlying the observed patterns, possible scale-dependence in species responses and how they vary depending on the level of fragment-matrix contrast. Working within a system with high fragment-matrix contrast, a set of land-bridge islands in Gatun Lake, Panama, we investigated the relative influence of local-scale versus landscape characteristics and the importance of spatial scale in determining species richness and composition of phyllostomid bats on islands. We further assessed patterns of species loss and changes in species composition on islands relative to mainland assemblages and possible edgerelated gradients in these attributes between interior and edge sites in continuous forest. Bats were sampled over a 2-year period on 11 islands as well as at forest edge and interior sites on the mainland, resulting in > 8,400 captures. Overall, the islands harbored a less diverse and structurally simplified bat fauna where far islands were especially species-poor. This decline in species richness was associated with compositional shifts towards assemblages strongly dominated by frugivores with good dispersal abilities while members of other feeding guilds, most importantly gleaning animalivores, were much less common or absent. Although overall species composition was not significantly altered, similar trends were already apparent at continuous forest edge sites where species richness was significantly lower compared to interior sites. Distance from the mainland and amount of forest cover in the landscape were the best predictors of species richness and assemblage composition of bats on our study islands. Responses were scale-dependent. At the local scale,
species richness was found to be independent of island area but positively correlated with isolation. By contrast, area effects became more important at larger spatial scales suggesting that many species typically make use of multiple fragments.

Keywords: bats, edge-effects, fragmentation, landscape structure, spatial scale

14:40 Relationships between edge effect and bat assemblages in Andean forest fragments

Aida Otalora-Ardila [1] and **Hugo F. Lopez Arevalo** [2]
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[2]Instituto de Ciencias Naturales, Grupo en Conservación y Manejo de Vida Silvestre, Universidad Nacional de Colombia, Bogota D.C.
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The edge effect is one of the consequences of forest fragmentation and may affect the wildlife communities and ecological processes in several ways. Trophic guilds and species of bats show differential responses to this phenomenon. We describe changes at composition, diversity species and guilds associated in a forest-pasture gradient and we hypothesize that species diversity will be lesser in the edge than in the forest interior and that shrub frugivorous species, aerial insectivorous and sanguivore species will be more abundant in the edge whereas canopy frugivorous, gleaning insectivorous and nectarivorous will be more abundant in the forest interior. A bat sampling with 16 mist nets during 106 nights that covered an interior-matrix gradient in four subandean forest fragments (10-50 ha) was made and 709 individuals of 24 species belonging to Phyllostomidae and Vespertilionidae family were captured. The richness, species and guilds diversity reach the largest values in the matrix and the edge. An indirect edge effect is suggested where richness, species and guild diversity increases in the patch boundaries related probably with edge vegetation changes and the alteration of interaction species is possible where the generalists species are possibly favored by cross-boundary subsidies.

Keywords: bat assemblages, richness, species diversity, guilds diversity, edge effect

15:20 Foraging behavior of nectarivorous bats in disturbed and undisturbed habitats in tropical dry forest

Selene Maldonado López, Kathryn E. Stoner, Mauricio Quesada, Yvonne Herrerías-Diego and David Uribe
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More than 500 species of plants are visited and presumably pollinated by bats in the Neotropics. Nectarivorous bats are threatened by habitat disturbance that diminishes available food resources and thus often results in behavioral changes that may ultimately alter the reproductive success of bat pollinated plants. In the tropical dry forest on the pacific coast of Mexico, the auto-incompatible tree *Crescentia alata* (Bignoniaceae) is an important food resource for the nectarivorous bats *Leptonycteris curasoae* and *Glossophaga soricina*. The objective of our study is to compare the foraging behavior of these two species in *C. alata* in disturbed and undisturbed habitats and determine the implications on reproductive success. We hypothesize that differences in resource availability of *C. alata* between habitats will result in fewer visits, less pollen transferred to the stigmas, and lower fruit set in disturbed habitats compared to undisturbed habitats. Bat activity was recorded using infrared digital videotaping starting at sunset for 4.5 hours. Resource availability was estimated each night by counting the number of open flowers in the filmed trees and in neighboring conspecifics. Stigmas were collected from disturbed and undisturbed habitats and pollen grains deposited were quantified with

epifluorescent microscopy. Reproductive success of *C. alata* was estimated by using a *fruit-set* coefficient. More visits and greater resource availability were observed in undisturbed habitats. Furthermore, the number of visits was positively influenced by resource availability. No relationship was found between number of visits and pollen grains deposited. Unexpectedly *fruit-set* was significatively higher in disturbed habitats. One explanation for these results may be that the greater number of flowers available in undisturbed sites allows bats to forage within the same tree longer, thus resulting in more geitonogamic crosses. In disturbed habitats with fewer flowers, bats must necessarily forage in different trees moving pollen more often between trees.

Keywords: *Leptonycteris curasoae*, *Glosshophaga soricina*, *Crescentia alata*, resource availability

15:40 The role of frugivorous bats in tropical succession

Robert Muscarella and **Theodore Fleming**
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Discussion of successional change has traditionally focused on plants. The role of animals in producing and responding to successional change has received far less attention. Dispersal of plant propagules by animals is a fundamental part of successional change in the tropics. Here we review the role played by frugivorous bats in successional change in tropical forests. We explore the similarities and differences of this ecological service provided by New and Old World seed-dispersing bats and conclude with a discussion of their current economic and conservation implications. Our review suggests that frugivorous New World phyllostomid bats play a more important role in early plant succession than their Old World pteropodid counterparts. We propose that phyllostomid bats have shared a long evolutionary history with small-seeded early successional shrubs and treelets while pteropodid bats are principally dispersers of the seeds of later successional canopy fruits. When species of figs (*Ficus*) are involved in the early stages of primary succession (e.g., in the river meander system in Amazonia and on Krakatau, Indonesia), however, both groups of bats are important contributors of propagules. Because they disperse or sometimes pollinate canopy trees, pteropodid bats have a considerable impact on the economic value of Old World tropical forests; phyllostomid bats appear to make a more modest direct contribution to the economic value of New World tropical forests. Nonetheless, because they critically influence forest regeneration, phyllostomid bats make an important indirect contribution to the economic value of these forests. Overall, fruit-eating bats play important roles in forest regeneration throughout the tropics, and their conservation is highly desirable.

Keywords: seed dispersal, succession, bats

3 Part II: The impact of plant phylogenies on tropical ecology and evolutionary studies

MONDAY, JULY 16
Room 3: Cervantes Saavedra (Second Floor)
Building:Colegio Primitivo de San Nicolás de Hidalgo

Organized by:

- M. Alejandra Jaramillo, University of Missouri-Columbia, Div. Biological Sciences
- Lúcia G. Lohmann, Universidade de São Paulo, Instituto de Biociências, Departamento de Botânica

14:00 Extreme long distance dispersal of a lowland rainforest tree (*Ceiba pentandra*: Malvaceae) across the Neotropics and Africa

Christopher W. Dick [1, 2], Eldredge Bermingham[2], Maristerra R. Lemes[3] and **Rogerio Gribel[3]**
[1] Department of Ecology and Evolutionary Biology and Herbarium, University of Michigan
[2] Smithsonian Tropical Research Institute
[3] Instituto Nacional de Pesquisas da Amazônia (INPA), Laboratorio de Genetica e Biologia Reprodutiva de Plantas

Many tropical tree species occupy continental expanses of rainforest and flank dispersal barriers such as oceans and mountains. Phylogenetic techniques can be used to infer the geographic origins of such species and test whether their broad geographic distributions arise from vicariance or long distance dispersal (LDD). This talk focuses on the biogeographic history of the kapok tree, *Ceiba pentandra* (Malvaceae), which is naturally widespread across equatorial Africa and the Neotropics. Phylogeography and molecular clock methods are used to show that *Ceiba pentandra* originated in the Neotropics and dispersed via wind or marine currents to equatorial Africa. Within the Neotropics *C*. *pentandra* spread to Caribbean islands and across the Northern Andes by long distance dispersal. In Africa, *Ceiba pentandra* experienced pronounced ecological divergence in savannah habitat. *Ceiba pentandra* is one of many rainforest tree taxa that display the amphiatlantic distribution. The study illustrates how long distance dispersal, via wind or marine currents, produces taxonomic similarities in the rainforests of Africa and the Neotropics.

14:20 Phyloepidemiology: ecological consequences of the phylogenetic signal in plant pathogen host ranges

Gilbert Gregory[1] and **Campbell Webb [2]**
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Most plant pathogens are polyphagous, but each fungal pathogen can attack only a subset of plant species in a diverse local community. Cross-inoculations with necrotrophic foliar pathogens from rainforest plant species showed a broad spectrum of host ranges, with a median of 27% of species susceptible. Species and genus specialists are rare; instead, there was a strong, continuous phylogenetic signal in the host range. When tested on congeneric hosts, two-thirds of pathogens caused disease on both hosts, with the likelihood that two plant species would share a particular pathogen declining continuously to 30%, when plant pairs were separated by 233 My of independent evolution. If plant pathogens are important in maintaining diversity in tropical forests as has often been suggested, local host selectivity is essential. The observed phylogenetic signal in host ranges suggests that pathogens may be more important in maintaining diversity at higher phylogenetic levels. At the same time, the phylogenetic diversity of a plant community may determine the apparent degree of specialization within the associated fungal community. In diverse tropical forests where phylogenetic distances among plant species vary continuously from very close to very distant relatives, the polypore fungal community is dominated by non-specialists. In contrast, in species-poor mangrove forests where phylogenetic distances among tree species are generally large, the fungal community is dominated by host specialists.Understanding the phylogenetic structure of pathogen host range provides a new tool for the study of the evolutionary ecology of plant diseases in tropical ecosystems.

Keywords: fungal diversity, disease ecology, Panama, host specificity, phylogenetic ecology

14:40 Phylogeny and the ecological distribution of C4 grasses

Erika J. Edwards[1] and **Chris J. Still**[2]
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C4 photosynthesis refers to a suite of biochemical and anatomical traits that reduce photorespiration in plants and promote photosynthetic efficiency in high light, high temperature environments. While the C4 pathway has evolved in numerous angiosperm lineages, it is most common in the grasses. Globally, C4 grasses are dominant members of tropical grassland/savanna communities and are conspicuously absent from cooler climates. There are well-understood physiological mechanisms that have been invoked to explain this pattern; however, C4 photosynthesis evolved exclusively in grass lineages of tropical origin, so an alternative and untested hypothesis is that C4 grasses were pre-adapted to warm climates and that photosynthetic pathway variation is not the primary driver of perceived C3/C4 sorting along temperature gradients. We tease this problem apart by analyzing the climate niches of 156 species of the Hawaiian grass flora within a phylogenetic framework. Using climate data from location points for over 3500 georeferenced herbarium specimens and current knowledge of evolutionary relationships within Poaceae, we find strong phylogenetic conservatism for all climate parameters. Most cool climate grasses belong to the BEP grass clade, while most warm climate grasses belong to the PACCAD clade, which contains a mix of both C3 and C4 species.

Within the PACCAD clade, shifts to C4 photosynthesis are more tightly correlated with lower precipitation than with higher temperatures. Additionally, divergences in temperature profiles between C4 sister taxa are significantly smaller than those between C3 sister taxa or C3/C4 splits. These results suggest that the relationship between C4 grass distribution and climate is complex, and that the broad global patterns correlating C4 abundance with high temperatures may be mostly due to historical effects. Furthermore, C4 photosynthesis may in part be limiting ecological diversification by restricting the realized temperature ranges of C4 species.

Keywords: C4 grasses, ecological sorting, Hawaiian Islands, phylogeny, niche evolution

15:20 Diversification in tropical wet forests: evolution of *Piper* in the Neotropics

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Piper, with > 1000 species, is one of the 10 largest genera of flowering plants. *Piper* plants thrive in wet tropical forests where they are a dominant element of the forest understory. *Piper* offers an excellent opportunity to test hypothesis about diversification in the wet tropics and the importance of geography in this process. Analyses of the species geographic distribution in the Neotropics suggest that the *Piper* flora can be divided into four major biogeographic components: Central America, the Andes, the Amazon and the Atlantic Forest (AF) of Brasil. There are a few species that occur throughout the Neotropics, nevertheless most species are restricted to one of the sub-regions or, even, portions of them: Central AF, the Choco Region (ChR), or the Antilles. We use a comparative method based on a robust phylogenetic framework to test hypothesis of geographic diversification of the genus in the Neotropics.

Keywords: wet forests, phylogen

15:40 The origin and radiation of the Andean Espeletiinae: do chloroplast and nuclear gene phylogenies disagree?

Jason Rauscher
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The subtribe Espeletiinae (Asteraceae: Millerieae) includes more than 130 species and 8 genera endemic to the tropical montane paramos of northwest South America. Despite its recent (<3-5 my) origin, this group exhibits extraordinary diversity of morphology, life form and ecology. Morphological divergence has made an understanding of its phylogeny elusive, but recent molecular studies have provided insights, such as the identification of Ichthyothere as its closest living relative. Phylogeny at the species level has proved more challenging due to low genetic variation. Nuclear ribosomal DNA-ITS data has led to new hypotheses of the evolution and biogeography of the group by identifying clades that are congruent with both morphology and geography of the Andes.

Preliminary sequencing of >20 chloroplast regions has also revealed low levels of variation. However, sequencing of 8 of the most variable of these regions for a sample of 30 species is beginning to elucidate the chloroplast phylogeny for the Espeletiinae. The results point to significant topological conflicts between the chloroplast and ITS phylogenies, particularly in the rooting of the tree, which has important implications for the origin and early evolution of this radiation. While lineage sorting or homoplasy may explain intergenic conflict, species interfertility and the apparent frequency of hybridization could also explain this pattern, through the genetic effects of diploid hybrid speciation and/or introgression. A study of chloroplast and ITS diversity across a hybrid zone between two Venezuelan species reveals complex patterns of genetic diversity and introgression that may support the hypothesis that hybridization is the source of the ITS/chloroplast conflict. Ultimately, understanding the evolution of rapidly evolving groups such as the Espeletiinae will require careful interpretation of multiple gene phylogenies as well as detailed studies of the morphology, ecology, ecophysiology and palynology of these species.

Keywords: andes, paramo, espeletiinae, phylogeny, hybridization

16:00 The evolutionary history of the fig-fig wasp mutualism

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I will provide an overview of our current knowledge on the evolutionary history of the fig/fig wasp mutualism. I will focus on recent work in my lab that is addressing the consequences that the presence of multiple pollinators per fig species has had on patterns of divergence in figs, using an example from a Neotropical group of species from section Urostigma Americana.

6 Gradients in plant-herbivore interactions involving tropical systems

MONDAY JULY 16
Room 4: Sala Rectores (Second Floor)
Building: Centro Cultural Universitario

Organized by:
- Robert Marquis, Dept. Biology, University of Missouri-St. Louis
- Karina Boege, Universidad Nacional Autónoma de México, Instituto de Ecología

The goal of this symposium is to provide an overview of the current available information regarding patterns in plant herbivore interactions, and their interactions with the natural enemies, among tropical habitat types and biomes, and across latitudinal gradients that include tropical systems. In so doing, our aim is to present, and when possible test hypotheses about what factors control populations of tropical insect herbivores and their species richness, and the resulting impact of those herbivores on host plant populations and plant communities. Although these questions have addressed at individual locations, few cross location studies have been performed. Thus, we have only limited information about how habitat type, successional stage, annual rainfall, soil nutrient status, elevation, and latitude contribute to what happens locally. Comparative studies are becoming sufficiently numerous to allow such comparisons. By bringing together researchers who are making such comparisons our intention is to gain insight through comparison, discussion, and meaningful synthesis of current results, and to inspire future research using this approach.

14:00 Herbivores and herbivory across two soil types in a Borneo rain forest

Markus P. Eichhorn[1]
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The role of herbivory in segregating species between soil types within rain forests is poorly understood and theoretical predictions are often conflicting. The Biological Interactions in Tropical Rain Forests (BITRF) project planted five species of dipterocarp tree seedlings in experimental plots on two soil types in both gaps and understorey. Seedlings on sandstone soils had greater concentrations of foliar phenolics and lower nitrogen than on alluvial soils, but insect herbivores were apparently unable to distinguish between leaves from plants grown in sandstone and alluvial soils in trials. Insect herbivores on the seedlings had reduced abundance and species richness on sandstone soils. Nevertheless, herbivory rates on the two soil types were equivalent over two years, with no evidence of differential impacts on growth or mortality.

keywords: Herbivory; insect; dipterocarp; soil type; specialisation

14:20 Leaf herbivore richness and diversity on plant species in burned and unburned plots in the Brazilian Cerrado

Ivone R. Diniz, John D. Hay, Helena C. Morais, Cintia L. Gonçalves, Bárbara F. Higgins

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This study examines the effect of fire frequency and time of year on Lepidopteran larvae on species of host plants in the Cerrado. The following questions were raised: Is abundance and species richness higher in burned areas? Does species composition vary among areas? The study was done in central Brazil with following treatments: 1) occasional fires (intervals of 7 and 11 years), 2) biennial fire in August (mid dry season), and 3) biennial fire in September (end dry season). For both biennial sites, the fire regime started in 1992. At the occasional fire site, two species of *Erythroxylum* (Erythroxylaceae) were studied using 1000 individuals of each species. At the biennial sites we studied *Byrsonima coccolobifolia* (Malpighiaceae) using 900 individuals in each area. Results were compared with nearby protected sites. At the occasional fire site larval abundance was 2X higher in the burned site but the proportion of parasitism was similar; species richness was higher in the burned area (37) versus protected (29); three species of Gelechiidae were the most abundant and were found on both plant species in both areas. For the biennial fire sites larval abundance in the unburned area was 3.5X (August) to 5X (September) higher than in the burned sites; larval species richness in the unburned area (36 spp) was 1.5X and 2.6X higher than in the burned areas; the fauna varied between areas with predominance of rare species and Elachistidae in the unburned area and predominance of Noctuidae and Elachistidae (*Stenoma salome*) in both burned areas. The results indicate that frequent fires drastically reduce the abundance and richness of larvae, especially in late dry season fires, while occasional fires may be a positive factor for renewing and maintaining Lepidoptera diversity in the Cerrado.

Keywords: Lepidoptera, fire, disturbance

14:40 Ant-plant-herbivore interactions and the divergence in the defensive ecology of *Inga* between two Neotropical sites

Tania Brenes-Arguedas [1], Phyllis D. Coley [2] and **Thomas A. Kursar [2]**
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Plants have evolved a diverse array of defensive adaptations which can vary widely among populations due to differences in the environment. It has been hypothesized that seasonality correlates inversely with pest pressure and thus plant defensive investment. We provide evidence that differences in ant and herbivore abundance between two communities influence the divergence and types of defensive strategies in 18 species of the genus *Inga* (Fabaceae: Mimosoideae). We compared chemical and ant defenses in *Inga* at two sites: the aseasonal Amazonian forest of Yasuni, Ecuador and the seasonal forest of Barro Colorado Island (BCI), Panama. Because ant abundance was 2.5 times higher at Yasuni, Yasuni Ingas relied more on ant defenses and leaf extracts were on average 50% less bioactive than at BCI. Bioactivity of Yasuni Ingas varied widely among species and was negatively correlated with ant visitation. In contrast, due to low ant abundance, most species at BCI had low ant visitation and high bioactivity. Reciprocal transplants with *I. spectabilis* suggest that Ingas experience higher herbivore pressure at

Yasuni. However, leaf damage was similar both between sites and among most species, indicating that different defensive strategies were equally effective. These results suggest that ant abundance, potentially linked to seasonality, drives the defensive strategies expressed by *Inga* species and promotes defense diversity within the genus.

Keywords: *Inga*, herbivory, ant defenses, chemical defenses, trade-offs

15:20 Is seasonality a driver of herbivory and defense?: A comparison between tropical dry and rain forests

Karina Boege[1] and **Rodolfo Dirzo**[2]
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Herbivores can have a significant impact on plant fitness and thus represent a selective force for the evolution of plant defenses. However, plant phenology can influence such impacts by determining the availability of foliage for herbivores and the risk of herbivore attack. We developed a conceptual model to predict how rainfall seasonality, and as a consequence leaf phenology of tropical rain forest (TRF) and tropical dry forest (TDF) plants bring about contrasting patterns of herbivory and defense in these two tropical ecosystems. We predicted that higher constancy of foliage, implying greater risk and impact of herbivory in aseasonal TRF plants, may lead to a greater evolutionary history of herbivory selecting for increased defense and lower herbivory than in plants of TDF with a marked rainfall seasonality. The predicted patterns were evident when we controlled for interspecific heterogeneity in herbivory and defense within both TRF (due to contrasts in life history and growth) and TDF (due to contrasts in phenology). Analyzing the available data in the literature and from our own ongoing work, we found that damage of TDF deciduous species was two-fold greater than that of slow-growth TRF species. The leaves of slow-growth TRF had twice the concentration of total phenolics and were 10-times tougher than leaves of deciduous species from TDF. In addition, the expected patterns were mirrored using controlled intra-site (dry forest) comparisons looking at plants of contrasting phenologies. We found that TDF deciduous species had 2.8 times greater herbivory than evergreen species. We also found that the later had 60% greater concentration of total phenolics and their leaves were two-fold tougher than the former. In consistency with our conceptual model and predictions, we found that leaf phenology, as affected by rainfall seasonality, can produce contrasting ecological and evolutionary outcomes of the interaction between plants and their herbivores.

Keywords: Herbivory, defenses, seasonality

15:40 Role of latitude and phylogeny for plant defense traits in broad-leaved tree species

Robert J. Marquis[1], **Robert E. Ricklefs**[1] and **Luis Abdala-Roberts**[2]
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An often-stated hypothesis is that year-round herbivore attack in the tropics should result in the evolution of greater defense investment in tropical and than in temperate habitats. Previous literature surveys demonstrate that plant defense traits are higher in tropical broad-leaved trees than in their temperate counterparts. However, this conclusion is potentially biased by lack of control for the effect of host plant phylogeny. We tested for the effect of latitude while controlling for the effect of phylogeny: we compared a variety of leaf traits from different tree species of the same family, sampled in Panama (9° latitude, 31 species) and Missouri (39°latitude, 16 species). We hypothesized that there would be higher defenses (both physical and chemical) and lower nutrients in leaves of Panamanian trees than those of Missouri trees. As predicted, physical defenses and nutritional values were lower in Panama than Missouri: toughness and fiber (both acid-detergent and neutraldetergent) content were greater, and nitrogen lower. However, neither condensed nor hydrolysable tannins differed between locations, contrary to expectation. Our results show some support for the idea that herbivore attack throughout the year results in reduced leaf quality, but mainly through changes in physical characters and nutrition. Future studies should include sites at multiple latitudes, all while controlling for phylogeny, to determine whether there is a gradient or in contrast, an abrupt shifts in leaf quality with changing latitude.

Keywords: herbivory, plant defenses, leaf traits, latitudinal gradients, phylogeny

16:00 Latitudinal and climatic gradients in tritrophic interactions

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Tritrophic interactions are expected to be different in tropical communities simply because of the increased diversity for most taxa at all trophic levels. However, many of the assumptions about how tropical communities are different from their temperate counterparts are not well tested and could be incorrect. Utilizing data from large caterpillar rearing projects around the world and meta analyses from published studies, I tested the following prominent assumptions for tropical communities: 1) chemical defenses are more abundant and toxic in the tropics, 2) herbivore specialization decreases with latitude, 3) predation is more intense in the tropics, and 4) multitrophic mutualisms are more important for tropical communities. Plant chemical defense, dietary specialization, and strength of trophic cascades all decreased significantly with latitude. Gradients in climatic variability and rainfall were the best predictors of parasitism and other trophic interaction variables that did not vary with latitude. Understanding mechanisms underlying these gradients will contribute to clarifying issues
about climate change, resiliency of tropical ecosystems, and the origin and maintenance of high tropicaldiversity.

Keywords: tritrophic, gradients, caterpillars, specialization, parasitism

7 TROPI-DRY Part I: Human and Biophysical Dimensions of Neotropical Dry Forests: Results from a Collaborative Research Network

MONDAY, JULY 16
Room 5: Aula Mater (First Floor)
Building:Colegio Primitivo de San Nicolás de Hidalgo

Organized by:

- G. Arturo Sanchez-Azofeifa, Tropi-Dry Principal Investigator, Earth and Atmospheric Sciences Department, University of Alberta, Canada
- Mauricio Quesada, Centro de Investigaciones en Ecosistemas, Universidad Nacional Autonoma de Mexico
- Geraldo Wilson Fernandez, Biology Department, Universidade Federal de Minas Gerais, Belo Horizonte, Minas Gerais
- Jon Paul Rodriguez, Instituto Venezolano de Investigaciones Cientificas (IVIC), Caracas, Venezuela

The main goal of this symposium is to present results from a collaborative research network conducting research on Neotropical Dry Forests. This network, funded by the Inter-American Institute for Global Change Research (IAI) is denominated TROPI-DRY. TROPIDRY's main objective is to contribute to a better understanding of the biophysical and human dimensions of mature and secondary dry forests in the Americas, with one specific goal: the translation of this knowledge into information that can be used by managers and policy makers towards the development of strategies aimed at the conservation of this important ecosystem. We include a series of presentations of research findings from four main TROPI-Dry sites: Mexico, Costa Rica, Venezuela and Brazil. The topics will cover three main areas associated with important conservation issues of tropical dry forests: Ecology, Remote Sensing and the Human Dimension.

14:00 Extent, threats and conservation of tropical dry forests in the Americas

Carlos Portillo-Quintero and **G. Arturo Sanchez-Azofeifa**
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The neotropical dry forest ecosystem is the most threatened ecosystem in the tropics. However, the scientific community still lacks the basic information necessary to design and propose conservation priorities. There is an immediate need to know how much of the ecosystem is left and where is it located, and what are the principal threats to the maintainance of its integrity. Over the last two decades, several efforts have contributed to understand the distribution of tropical dry forests at the global and regional scale using

remotely sensed data. Here, we will present a review of those results and highlight how the gaps and inconsistencies that persist in these datasets still prevent us from further use in forest conservation and management. To help assess these issues, we introduce technical considerations to achieve better extent estimates, especially by taking into account latitudinal shifts in phenology for proper selection of imagery, detecting the presence of evergreen variants of the tropical dry forest and including a thorough accuracy assessment. To evaluate threats to neotropical dry forest, we show the data from scientific reports on the conservation status of thirty-five tropical dry forest ecoregions (World Wildlife Fund) and recognized the major threats reported for continental and insular ecoregions. For insular regions the main driving forces (defined as the forces that it are identified on more than 50% of all sites) are: invasion of exotic species, urban sprawl, selective logging, agriculture, tourism development and road construction. In the continental sites the main identified driving forces are: agriculture expansion, cattle ranching and grazing, selective logging, urban sprawl and hunting. We also analyze the distribution of active fires detected during the years 2002, 2003 and 2004 by the MODIS sensor within the neotropical dry forest biome and show potential deforestation frontiers at the continental scale.

Keywords: Tropical dry forests, Tropi-Dry, MODIS, remote sensing.

14:20 Changes in tree and liana communities along a successional gradient in a tropical dry forest in southeastern Brazil

Mário M. Espírito-Santo[1], Bruno G. Madeira, Santos D'Ângelo[1], Yule R. F. Nunes[1] G. Arturo Sanchez Azofeifa[2], Geraldo W. Fernandes[3] and **Mauricio Quesada[4]**
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This study aimed to investigate the changes in composition and structure of tree and liana communities along a successional gradient in a seasonally dry tropical forest (SDTF) in Southeastern Brazil. We selected 6 plots of 50 x 20 m (0.1 ha) at the early (≈ 5 years since abandonment) and intermediate (≈ 15 years since abandonment) stages, and 8 plots in the late stage (no record of clear-cutting in the last decades). In these plots, all trees with diameter at breast height (DBH) ≥ 5 cm were marked and identified, and all lianas ≥ 2 cm were marked. All plant had their DBH and height measured. We found 1,543 tree individuals, representing 76 species. Species richness increased along the successional gradient, with marked changes in composition and dominance from the early to the other stages. There was an increase in all tree structural traits (DBH, height, stem and species density) from the early to the late stages, as predicted by models of ecological succession. In contrast, liana density decreased from intermediate to late stages, showing a negative correlation with tree density. The same decrease was also observed for liana basal area, probably due to a decrease in light availability as the tree canopy closes in late stages. Patterns in tree community composition and structure were compared to those recorded for other SDTFs in Brazil and the Americas. This is the first study that analyzed changes in liana structure along a successional gradient in SDTFs.

Keywords: Brazil, tropical dry forests, Tropi-Dry, ecosystem structure, composition

14:40 Functional traits of woody species growing under different successional stages of a tropical dry forest

Mariana Y. Alvarez-Anorve[1], Mauricio Quesada[1] and **G. Arturo Sanchez-Azofeifa[2]**
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Secondary Tropical Dry Forests have been poorly studied despite their ecological importance and recent expansion due to land-use changes. The identification and characterization of these systems is, however, crucial for the understanding of the natural regeneration processes as well as to determine the area covered by secondary vegetation. In order to develop techniques oriented to identify and characterize several types of secondary dry forests, we intend to determine functional groups of plant species from different successional stages. Field work was conducted in Tropical Dry forest of Chamela, a highly diverse tropical system located on the Pacific coast of Mexico. We evaluated the following morphological and physiological attributes: maximum photosynthesis, leaf dynamics, relative growth rate and different leaf traits (Specific leaf area, blade shape, thickness, water content, chlorophyll content and spectral reflectance). For these purpose, we selected nine 50*20 m plots representing three different successional stages (early, intermediate and late) of Chamela Tropical Dry Forests. We then identified the most abundant woody species occurring in each stage and, during the 2006 rainy season, we carried out the correspondent measurements for adult trees of 30 species. Preliminary data analysis suggests that attributes such as photosynthesis, specific leaf area and chlorophyll content account for a substantial part of the functional differences observed among plants from different successional stages. By relating these attributes to the spectral reflectance of each species, we will be able to recognize the different types of secondary Tropical Dry Forests using remote sensing technology.

Keywords: tropical dry forests, Tropi-Dry, spectroscopy, functional traits

15:20 Multi-scale assessment of tropical dry forest extinction risk and conservation priorities in northern Venezuela

Rodríguez, Jon Paul[1,2], Jafet M. Nassar[1], Kathryn M. Rodríguez-Clark[1], Carlos A. Portillo Q.[3], Irene Zager[2], Fabián Carrasquel[2], and **Sergio Zambrano[1]**
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Numerous schemes exist for ranking ecosystems in terms of their conservation priority. Most use categories which express the urgency of needed conservation actions. This is

in contrast to current trends in species red listing, which explicitly seek to avoid confounding risk assessment (a scientific process) with priority setting (a societal process). Here, we specifically avoid this problem in our assessment of the extinction risk of tropical dry forests in a 6,500 km^2 area in northern Venezuela, using a system analogous to the IUCN Red List of Threatened Species. Assessments were performed at scales that ranged from natural divisions of space (ecosystem types, watersheds), through human constructs (states, municipalities), to fully arbitrary units (grid cells). We classified land cover using satellite images taken in 1986 and 2001, and quantified changes at the spatial scales mentioned above, focusing on natural vegetation (deciduous, semideciduous and evergreen forests). We show that, although tropical dry forests in our study region are threatened (including those located inside protected areas), since extinction risk depends on the scale of the analysis, a high probability of extinction does not obviously lead to higher conservation priority. The decision of where to invest limited conservation funds should consider our results, but also include information on biological uniqueness, global importance, legal and logistical context, and the public's preferences.

Keywords: Venezuela, Tropi-Dry, tropical dry forests, conservation

15:40 Mapping liana coverage from hyperspectral data in a tropical dry forest: leaf and crown levels

Margaret Kalacska and **G. Arturo Sanchez-Azofeifa**
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The separability of the spectral signatures of tropical dry forest (Parque Natural Metropolitano, Panama) lianas and trees area examined at two scales: leaf and crown. The leaf level data consisted of in-situ spectra collected from leaves accessed by the canopy crane while the crown level data consisted of an airborne hyperspectral image. We compare three different hyperspectral data reduction techniques in conjunction with pattern classifiers to separate the spectral signatures. At the leaf level, the forward feature selection (the selection of a subset of wavelengths) method for reducing the number of bands had the best results with non-parametric classifiers with an overall error less than 1%. At the crown level there was no clear optimal method for reducing the dimensions (i.e. number of bands). The overall error was higher (7%) than at the leaf level. It was also found that the most important wavelength regions for separating the spectra of lianas and trees differ between the leaf and crown scales.

Keywords: Panama, Tropi-Dry, Tropical dry forests, hyperspectral remote sensing, lianas

16:00 The effect of forest age on response to climatic variation in tropical dry forests: regional to continental scales

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Highly seasonal rainfall creates a pulse of litterfall in the southern Yucatan peninsula region, with cascading effects on the timing of essential nutrient fluxes, microbial dynamics and the growth of the vegetation. I investigated whether forest age or a regional environmental gradient related to rainfall has a greater effect on patterns of litterfall in this increasingly human-dominated landscape. Litterfall was sampled in ten to thirteen stands in each of three locations spanning a rainfall gradient of ca. 900 – 1400 mm/yr. Litter was collected monthly from November 1998 through January 2000 in mature forests and in secondary forests aged 2-25 yrs. Despite a substantial precipitation gradient, age was the only significant predictor of annual litter mass. Two to five yr old forests produced significantly less litter than 12-25 yr old secondary forests (4.6 vs. 6.2 Mg/ha/yr), but the difference between older secondary forests and mature forests (9% greater) was not significant. Litter production increased with rainfall, but not significantly so. The pattern of litterfall was similar across locations and age classes, with a peak during late March or early April. However, litterfall seasonality was most pronounced in the old secondary and mature forests. Litterfall was more evenly distributed throughout the year in forests under 10 yrs old. Seasonality of litterfall was also less pronounced at the wettest site, with less disparity between peak litterfall and off-peak months. Seasonality was not related to soil texture. Forest age and rainfall are important drivers of litterfall dynamics, however, both litter mass and degree of seasonality depended more strongly on forest age. Thus, the impact of land-use change on litter nutrient cycling is as great if not greater than the constraint imposed by the major natural environmental factor affecting tropical dry forests.

Keywords: Mexico, Tropi-Dry, Tropical dry forests, litterfall

8 Part I Managing Tropical Agricultural Landscapes to Enhance Biodiversity

TUESDAY, JULY 17
Room 1: Teatro José Ruben Romero
Bulding: Teatro José Ruben Romero (Auditorium)

Organized by:

- Robin L. Chazdon, Dept. of Ecology and Evolutionary Biology, University of Connecticut

Traditionally, conservation of biodiversity in the tropics (and biodiversity studies in general) have focused almost exclusively on reserves and protected areas, rather than considering the broader agricultural landscape surrounding protected areas. Management of land use, agricultural systems, and spatial configuration of forest cover within agricultural landscapes can potentially mitigate some of the negative effects of forest fragmentation and reduction of prime forested habitat. Speakers will focus on applications of research to enhance biodiversity within agricultural landscapes in the tropics. Many of these speakers were participants in the NCEAS Working Group on Biodiversity and Conservation Value in Agricultural Landscapes of Mesoamerica, organized by Robin Chazdon and Daniel Griffith (2004-2006); however, we have attempted to broaden the scope of the symposium beyond Mesoamerica.

10:00 Maya agriculture and the forest matrix: intentional succession in the Lacandon rain forest

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Understanding agriculture in tropical secondary forest landscapes is inherently interdisciplinary, focusing the interest of the ecological, physical and social sciences. Emphasis is usually directed towards natural successional processes after human disturbance, yet intentional human management of the forest matrix was central to the history and genesis of Maya agriculture. To the present day, Mayan people farm in the forest and their traditional methods seek to shape and conserve that environment. Intervention in secondary succession after agriculture resulted in forest enrichment in ethnobotanical species, accelerated the recovery of soil fertility, increased biodiversity, helped control pests and enhanced landscape resilience. The Maya have viewed forests in similar ways to ecologists classifying trees according to their longevity and abundance in different successional stages. Our studies suggest that such Maya classes correspond to functional groups of woody species. We consider cases of managed succession in the eastern Chiapas and their potential of Maya practices to contribute to restoration in degraded areas.

Keywords: Secondary succession, Maya agriculture, management, forest matrix

10:20 Traditional agricultural practices enhance agro-biodiversity and pest management

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Agriculture is often perceived as a threat to conservation. There is evidence that agriculture based on monocrops, with heavy inputs of pesticides and fertilizers put biodiversity and ecosystems services at risk. Nevertheless, here I show that traditional agriculture practiced by small corn farmers from Chiapas and Guatemala may not only enhance agro-biodiversity and pest management, but also may contribute to biological conservation at the landscape level. Based on controlled field experiments and lab bioassays, I explore the role of traditional agricultural practices, involving soil fertility management, intercropping, weed managemen, and pest repellents, in the natural regulation of potential pests and in conservation. The data show that traditional corn plots maintain high diversity of plants, birds and insects, enhancing natural biological pest control and preventing pest damage. Many of these traditional practices could be useful in modern agriculture and could be promoted for conservation purposes. Agroecologists can help bridge the communication gap between traditional farmers on the one hand and conservationists and policy makers on the other.

Keywords: Agroecosystems, pest prevention, cultural practices, biological control, biodiversity

10:40 Biodiversity, ecological, and economic services in coffee agroecosystems

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Coffee agroecosystems are extremely important for biodiversity conservation and contribute to the economic well being of millions of producers. Dozens of studies have highlighted the importance of maintaining diverse coffee agroecosystems (including high tree diversity and density, canopy cover, epiphytes, etc.) for protecting biodiversity. Maintenance of diverse coffee systems may further promote ecosystem services such as pest control, protection from disease outbreaks, enhanced pollination, increased connectivity between forest fragments, and buffering against the effects of global environmental change. Coffee management choices also strongly influence coffee yields and the alternative products provided from the shade trees which can contribute to farmer incomes. We present here results of a quantitative synthesis of more than 40 studies examining the relationship between biodiversity of ants, birds, and plants and coffee management intensification. We also present a meta-analysis of the specific vegetation and site characteristics of coffee management systems that strongly correlate with species richness, especially that of forest species. We also briefly summarize the impacts of coffee management changes on different functional groups of ants, trees, and birds and discuss the implications for ecosystem services and economic outputs from coffee agroecosystems. The results from these studies can provide researchers, conservationists, and managers with information about which management factors most strongly affect biodiversity, and how management for biodiversity may influence the availability of alternative products, the prevalence of pests and disease, and the variation of coffee yields. Based on these results, we discuss management

recommendations for protecting both biodiversity and economic and ecological value of coffee agroecosystems.

Keywords: biodiversity, ecosystem services, agroecology, conservation, sustainability

11:20 Quantification of avian use of a shaded coffee plantation as a biological corridor

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Shaded agroecosystems, such as coffee plantations, are often assumed to function as a biological corridor for forest birds, although this assumption has not been tested. I recognize two types of avian users of such putative corridors: strict dispersers (forest specialists that only occupy the corridor matrix while dispersing to new forest habitat) and secondary corridor users (forest generalists that can breed within the corridor matrix). Corridor use by strict dispersers may be rare, difficult to detect in nature. Quantifying gene flow through corridors is methodologically challenging. I propose that long-term avian monitoring stations, using mark and recapture methods, can provide data useful for quantification of relative avian use of corridors. I provide an example from El Salvador with 30 months of monitoring data (7145 net-hours) collected at a shaded coffee plantation in the Apaneca biological corridor, which spans 30 km between El Imposible and Los Volcanes national parks. Of 59 resident bird species captured at the station, at least 12 (such as *Cyanocompsa parellina*) were strict dispersers from forests, being rarely observed, and captured in <10% of sampling months. The 18 individuals of these species represented 2.2% of resident bird captures, and were captured at a rate of 1 individual per 400 net-hours. Another 29 species, totalling 78% of resident bird captures and 37 birds per 400 net-hours, were secondary corridor users, breeding in local forests as well as in the corridor matrix. Probability of gene flow among forest patches is greatly increased for these species because of breeding within coffee plantations. Relative use of corridors can be compared across habitats for both types of avian corridor users, provided that differences in capture probabilities due to habitat structure are accounted for.

Keywords: biological corridor; agroecology; coffee; monitoring data; birds

11:40 Farmers, tree cover and biodiversity conservation in agricultural landscapes of Central America

Celia A. Harvey, Joel C. Saenz, Cristobal Villanueva, Rene Gomez, Marlon Lopez, Muhammad Ibrahim and **Fergus L. Sinclair**
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By actively managing the forest and tree resources that occur on their land, farmers can have an important impact on the ability of agricultural landscapes to conserve biodiversity. Farmer decisions determine the availability and distribution of forest patches, riparian forests and fallow areas; the densities, composition and spatial arrangements of dispersed trees and live fences on farms; and the ways in which forests and other tree resources are

managed (such as the use of fire and the harvesting of firewood or timber). Collectively these decisions shape the structure and composition of agricultural landscapes, with potentially profound impacts on the resident biodiversity. For example, when farmers select which naturally regenerating trees to maintain in their pastures, they generally reduce the overall tree diversity and tree density, and skew the species composition towards species that provide products to farmers (typically timber or fodder species), thereby affecting both the quantity and type of habitat and resources available to wildlife. Similarly, the planting of extensive networks of live fences can greatly enhance the structural connectivity of landscapes, facilitating the movement of some (but not all) animal species. Using interdisciplinary studies on the relationships between farmer decisions, land management and biodiversity from 4 cattle landscapes in Costa Rica and Nicaragua, we characterize the abundance and distribution of tree cover within agricultural landscapes, highlight the ways in which farmer decisions shape the forest and tree cover present in agricultural landscapes, and explore the impacts of these changes for the plant and animal diversity present. Our results highlight the urgent need to actively integrate farm management into landscape – level conservation planning and to create new alliances with farmers that permit the long-term management of agricultural landscapes for both conservation and production goals.

12:00 Rainforest trees outside forest fragments as seed sources and regeneration nuclei for forest recovery

Javier Laborde, Sergio Guevara and **Graciela Sanchez-Rios**
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Forest recovery in tropical pastures is limited by seed dispersal, mainly because the seed dispersers of woody plants avoid deforested areas and also because the potential seed sources of woody plants are too far away. In the fragmented landscape of Los Tuxtlas, Mexico we fenced in five fig trees isolated in pastures. We monitored seed deposition under their canopies over a year, and sampled soil seed content as well as the vegetation that had established after three years of cattle exclusion. Dispersal distances were estimated for captured seeds and established plants. Seventy tree and shrub species were captured in seed rain with a cumulative density of 833 seeds/m2/yr. Most of the captured seeds (>90%) were small (seed width <3mm). Soil seed content was dominated by ruderal herbs and was particularly poor in woody plants. After three years of exclusion, 77 species of trees and shrubs had established with a density of 4.0 plants/m2. Seeds <7 mm in diameter were frequently dispersed more than 75 m across the pasture. Larger seeds were dispersed over shorter distances and in much lower numbers, but once they arrived at the fig trees, germination and establishment success was higher than for small seeds. Rainforest trees left within pastures have an enormous potential for accelerating forest recovery by acting as regeneration nuclei when cattle is excluded. Because of their location, these trees are also extremely important seed sources for secondary succession, provided that they are visited by pollinators and seed dispersers. Current management practices can easily be modified to promote the preservation of rainforest trees within active pastures, particularly in the vicinity of protected areas. The inclusion of rainforest trees within agricultural areas can mitigate and even counteract the detrimental effects of forest fragmentation, and should be part of landscape restoration and landscape design initiatives.

Keywords: Dispersal limitation, landscape matrix, grasslands

9 Conservation Genetics of Tropical Vertebrates

TUESDAY, JULY 17
Room 2: Conservatorio de las Rosas (Auditorium)
Building: Conservatorio de las Rosas

Organized by:

- Sofia Solórzano, FES Iztacala, Universidad Nacional Autónoma de México, Mexico.
- Omar Chassin, Facultad de Biología-CMEB, UMSNH, Mexico
- Philip Hedrick, Arizona State University

One of the main goals of Conservation Genetics is to analyze the genetic risks that may cause the extinction of taxa. In tropical regions, large animals, endemic taxa, and small isolated vertebrate populations represent a priority for Conservation Biology since their populations have been severely impacted by habitat destruction. The effects of habitat destruction are different for many vertebrate groups such as Reptiles, Fish, Birds, and Mammals because they all possess different conservation strategies. The main goal of this symposium is to present the theoretical basis, the current status, and future perspectives of Conservation Genetics in tropical regions, as well as their applications to the conservation of tropical vertebrates. We include case studies that show both the methodological strategies and the main findings to accomplish the conservation of threatened animal species from different tropical regions. This symposium is sponsored by Comisión Nacional para el Conocimiento y Uso de la Biodiversidad (FU004), Mexico, and CIEco, UNAM, Mexico.

10:00 Genomics and the conservation of species

Stephen J. O'Brien.
Laboratory of Genomic Diversity. National Cancer Institute. Frederick, Maryland, USA.

Advances in population and quantitative genomics, aided by the computational algorithms that employ genetic theory and practice, are now being applied to biological questions that surround free-ranging species not traditionally suitable for genetic enquiry. My presentation will highlight applications of molecular genetic tools have been used to describe the natural history, present status, and future disposition of wild species of mammals. Insight into phylogenetic hierarchy, demographic contractions, geographic population substructure, behavioral ecology and infectious diseases have revealed strategies for survival and adaptation of many fascinating mammalian species. I will discuss the resolution of the earliest divergences of placental mammal forbearers, the phylogenetic hierarchy of the Felidae radiation, discovery of new species of mammals and examples of recent migration events in ancestral taxa revealed by genomic prospecting in modern big cat species.

10:20

Genetic diversity and molecular relationships among members of the genus *chirostoma* (Atherinopsidae: Menidiinae)

Irene de los Angeles Barriga-Sosa[1], Claudia Gárnica-Rivera[1], Mónica Y. Pérez-Ramírez[1], José Luis Arredondo-Figueroa[1], Rodrigo Moncayo–Estrada and Francisco J. García de León[2]
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The atherinopsids of the Central Mexico are a group of endemic fish species that have been for centuries an important natural resource for ethnic populations from lakes Patzcuaro, Chapala, Cuitzeo and Zirahuen. Presently, the effects of over-explotation, eutrophication and contamination are driving towards the loss of this biodiversity. Here are presented information regarding levels of genetic variation, and relations among *Chirostoma* species based on partial sequences of three mitochondrial DNA regions (control region (CR), 300 pb; cytochrome b (Cytb), 400 pb and r16S, 375 pb). The levels of genetic diversity (π) ranged from 0.00000 to 0.04282 for these three regions. As expected the levels of resolution were: CR resolved variation at the intra-specific level, cytb at the intra and inter-specific level and r16S showed the lowest levels of variation. CR and cytb showed overall sequence variation (N = 91) that resulted in 24 and 17 haplotypes, respectively and intermediate levels of nucleotide diversity (π = 0.04282 ± 0.00469; 0.0256 ± 0.00297, respectively). *Chirosotma jordani* showed the highest levels (0.03926 ± 0.01735), followed by *C. humboldtianum* and *C. estor* , (0.03393± 0.00162 and 0.01971 ± 0.00175, respectively), *C. labarcae* and the *Poblana spp*., had only one haplotype each and cero levels of diversity. The sequences of the r16S (N = 87, 375 pb) showed overall lower levels of diversity (0.01850±0.00291), with *C. jordani* showing the highest levels (0.01655±0.00668), followed by *C. humboldtianum* (0.00571±0.00044) and *C. estor* (0.00019±0.00017) and *C. labarcae* and *Poblana spp.,* showing only one haplotype each. The levels of genetic diversity and divergence between the species analyzed supported the genetic identity of the *Chirostoma* species, however a close monitoring should be carry out in C. *labarcae* and *Poblana* those species that showed the lowest levels of genetic variation in order to suggest further proceedings.

Keywords: *Chirostoma*, *Poblana*, Control Region, cytochrome b, r16S

10:40 Systematics and conservation genetics of the *Chelonia* genus: two approaches to one issue

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[2] Centro de Investigaciones en Ecosistemas, Universidad Nacional Autónoma de México
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There is a taxonomic controversy on the *Chelonia* genus, some authors argue that this is a monospecific genus and others argue that there are two different species (*C. mydas* and *C. agassizii*). Here we review this issue and its impact for conservation purposes

based on a molecular approach. Then we show a genetic analysis of the main continental nesting rookery of the east Pacific population that has suffered drastic population declines following intense exploitation in the 1960s-1970s. Analyses of three nDNA microsatellite loci and 400 bp mtDNA control region sequences from a total of 123 nesting females sampled at Michoacan state (Mexico) show no evidence of population sub-structuring and no apparent impact of population reduction on genetic diversity in either control region sequences (overall h = 0.48; = 0.0036) or microsatellite loci (overall Na = 20.8; Hexp = 0.895). Our estimates of annual effective female population size (Nef; from) of 1.9-2.3 x 103, in spite of being an order of magnitude below historical records, appear to be sufficient to allow recovery of this population without significant loss of genetic diversity. These findings highlight the importance of continued conservation activities to reverse the decline of this population, even there are no support for its taxonomic differentiation.

Keywords: *Chelonia*, Systematics, Conservation genetics

11:20 Establishing a general conservation strategy for threatened taxa based on ecologic and genetic data: the case of the Mesoamerican Resplendent Quetzal (Aves: *Pharomachrus mocinno*)

Sofia Solórzano[1] and **Ken Oyama**[2]
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Mesoamerica is a world hotspot area since it contains a high biodiversity. In this region are about 5% of threatened endemic vertebrates represented by small isolated remnant populations. Most of these taxa still remain without basic information that allows establishing conservation and management plans to long term. In the present study we propose a general strategy to establish conservation programs following available ecologic and genetic data. In this study we used the case of Resplendent Quetzal (*Pharomachrus mocinno*) a bird species worldwide listed into Lower Risk near Threatened but in each of the seven countries that it occupies is considered as endangered specie. This endemic Mesoamerican bird ranges from southern Mexico to northwest Panama showing an isolated distribution pattern. Recent studies showed that the 70% of the quetzal habitats were destroyed and consequently causing local extinctions at southern Mexico. Additionally, genetic analysis based on mtDNA sequences and morphological data showed strong partition within *P. mocinno*. Integrating all these data we propose that a strategy to establish conservation programs for quetzals and other vertebrate of similar status. 1) to evaluate quantitatively the potential threats, 2) to identify geographic areas that would be preserved to long term and, 3) to maintain the connectivity among such areas design a system of natural protected areas and biological corridors; 4) to overlap genetic analysis onto the geographical areas chose according with genetic identity, instead a detailed population genetic structure that is hard to accomplish considering the rarity and the small population sizes of endemic threatened taxa. Based on this strategy we found that in Mesoamerica there are about 12 highest priority areas that should be conserved to

maintain to long term Resplendent Quetzal populations. These areas need international agrees to guarantee that the connectivity among them.

Keywords: Mesoamerica, *Pharomachrus mocinno*, Conservation priority areas

11:40 Conservation genetics of Mexican Wolves

Phil Hedrick and **Fredrickson Rich**
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The Mexican wolf (*Canis lupus baileyi*) was hunted to near extinction in the middle of the last century. A captive breeding program for the Mexican wolf was established in the late 1970s from three founders (two other lineages, with two founders each were subsequently added). A reintroduced population of about 50 animals, descended from this captive population, exists in Arizona and New Mexico today. There is evidence of genetic rescue as the result of merging these three lineages in both the captive and reintroduced population. The captive populations of Mexican wolves has been closely managed to minimize mean kinship and there has also been an extensive effort to monitor wolves in the reintroduced population and determine their pedigree relationships. In addition, there have been efforts to augment and change the constitution of the wild population by releases from captivity. These management actions, the current status of the captive and reintroduced population, and potential recommended further management alternatives will be evaluated and discussed.

Keywords: genetics, Mexican wolves, inbreeding, genetic rescue

12:00 Perspectives of conservation genetics in tropical regions

Stephen J. O'Brien[1]**,**
[4]Arizona State University

No abstract available.

Discussion and final remarks: The creation of a conservation genetics network for tropical regions.

Sofia Solórzano[1]**, Omar Chassin**[2]**, and Philip Hedrick**[3]
[1]FES Iztacala, Universidad Nacional Autónoma de México, México
[2]Facultad de Biología-CMEB, UMSNH, Mexico
[3]Laboratory of Genomic Diversity, National Cancer Institute, Frederick, Maryland, USA

The objective of this final discussion is to identify a general strategy of conservation that is applicable for most tropical animal species, based on theory, experience and empirical data presented by the symposium speakers as general public. We will present a strategy for the creation of a Conservation Genetic network for tropical regions, and particularly for Latin America and Mexico.

10 Ecological theory and tropical ecology: bridging the gap for mutual gain

TUESDAY, JULY 17
Room 3: Cervantes Saavedra (Second Floor)
Building:Colegio Primitivo de San Nicolás de Hidalgo

Organized by:
- Helene C. Muller-Landau, University of Minnesota
- Jérôme Chave, CNRS, Toulouse

The goal of this symposium is to highlight the past and potential future gains for both tropical ecology and theoretical ecology from bridging the often large gap separating these two subdisciplines. Much ecological theory is inspired by the tremendous diversity of tropical forests, yet key assumptions are often unrealistic for tropical communities, making empirical application and testing difficult if not impossible. Further, empirical studies inspired by particular theories are often based on weak linkages to theory, and thus provide at best purely qualitative tests of hypothesized mechanisms. Nevertheless, our understanding of tropical forests has benefited from the development and testing of ecological theory related to the intermediate disturbance hypothesis, the Janzen-Connell model, and the neutral theory, to name just a few. In this symposium, we plan one talk on neutral theory, three talks on mechanisms of diversity maintenance, and two talks on phylogenetic structuring of communities. Each talk will include some theory, some tests of the theory against tropical forest data, and discussion of either how theoretical developments were inspired by or advanced by tropical forests and/or how our understanding of tropical forests was advanced by the theory and comparisons with theoretical predictions.

10:00 To what degree do stabilizing forces at different life stages contribute to tree species coexistence in tropical forests?

Liza Comita [1], Helene Muller-Landau[1], Richard Condit[2], S. Joseph Wright[2] and **Stephen Hubbell [3]**
[1]University of Minnesota
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[3]University of Georgia
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Theoretical work suggests both stabilizing and equalizing forces can contribute to species coexistence in diverse communities. Equalizing, or neutralizing, processes are those mechanisms that act to minimize fitness differences between species, while stabilizing, or frequency-dependent, processes are those that cause species to limit themselves more than they limit others. The presence of stabilizing processes can be assessed by comparing intra- and interspecific effects on species vital rates. However, stabilizing processes can operate on multiple life stages, therefore integrating intra- and interspecific effects across all life stages is necessary for quantifying the relative contribution of stabilizing processes to species coexistence in ecological communities.Using long-term data on seed dispersal, seedling establishment, and

seedling, sapling and tree survival and growth, in conjunction with Bayesian hierarchical models, we quantified the effects of con- and heterospecifics on vital rates across multiple life stages for co-occurring tree species in the moist tropical forest of Barro Colorado Island, Panama. We found that species are more negatively impacted by conspecifics than heterospecifics, consistent with stabilizing mechanisms. Such effects were found at multiple life stages, but were strongest in smaller size classes. This analysis represents a critical first step in using empirical data to determine the relative importance of stabilizing versus equalizing forces in diverse tropical tree communities.

Keywords: coexistence, density dependence, modelling, Janzen-Connell

10:20 Diversity-enhancing Janzen-Connell effects: what do our studies really tell us about their role in plant communities?

Helene Muller-Landau[1] and **Frederick R. Adler**[2]
[1]University of Minnesota
[2]University of Utah
Email: hmuller@umn.edu

Over 35 years ago, Janzen and Connell suggested that specialized natural enemies concentrate around adult trees, that these enemies elevate seed and seedling mortality near conspecific adults, and that this contributes to the maintenance of tree species diversity in tropical forests by preventing any one species from becoming very common. While we now have extensive empirical evidence for elevated mortality near conspecific adults and theoretical demonstration that such mortality contributes to diversity maintenance, we lack tools for extrapolating from quantities measured in the field to community-level effects on diversity. Fundamentally, the contribution of spatial Janzen-Connell effects to diversity maintenance depends on the strength of the resulting stabilizing effect of population-level negative frequency-dependence on the change in reproductive rate with relative abundance. Empirical studies have quantified not whole-population effects but local effects, specifically, changes in seed or seedling success as a function of the distance to conspecific adults or the local density of conspecific seeds or adults. Here, we use models to illuminate the links or rather, lack thereof between Janzen-Connell patterns that are or could be measured in the field and larger-scale influences on population regulation and community diversity maintenance. We first investigate how characteristics of specialized natural enemies and their host plant species influence plant populations and communities in models designed to capture key characteristics of tropical forests, including local resource competition. We then do field sampling within the simulated landscape to see what traditional empirical studies of Janzen-Connell effects might find, and evaluate the relationship between these observed patterns and actual effects on population regulation and species diversity.We find that the correlations are quite poor, and insofar as they exist, are often in the opposite direction of what might be expected. We close by discussing the implications for interpreting empirical patterns of densitydependence.

Keywords: enemies hypothesis, diversity maintenance, Janzen-Connell effects, density-dependence, seed dispersal

10:40 The evolution of tropical forest communities: what can phylogenetic relatedness tell us about community assembly in different habitats?

Steven W. Kembel
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The phylogenetic structure of ecological communities may provide insights into the relative importance of processes hypothesized to maintain species diversity, as these processes interact with the evolutionary history of plant niches and leave their signature on the phylogenetic relatedness of co-occurring species. The increasing availability of phylogenetic data for large numbers of species, along with data on the abundance and distribution of tropical trees, have been used to test for evidence of the various processes hypothesized to maintain the exceptional diversity of tropical forests. To date, most comparisons of empirical patterns with theoretical predictions have been based on qualitative models of the relationships between niche evolution, community assembly, and community phylogenetic structure. In this study, I use data from tropical forests on Barro Colorado Island, Panama, along with simulation studies, to quantify the ability of several proposed measures of phylogenetic diversity to detect evidence of competition and environmental filtering. Measures of community phylogenetic structure differed in their ability to detect processes influencing community assembly, and interactions between species frequencies, sample richnesses, environmental heterogeneity, community assembly processes and niche evolution sometimes made it difficult to attribute patterns of phylogenetic structure to any particular ecological or evolutionary process. However, phylogenetic relatedness varied a great deal among habitats and along environmental gradients within the forests on Barro Colorado Island. In young forests and plateau habitats, trees were more closely related to their neighbors than expected, while trees in swamp and slope habitats were more distantly related to their neighbors than expected. I discuss the potential importance of these results for our understanding of the relative importance of processes such as competition and filtering in structuring tropical forest communities, and the evolution of the niches and habitat associations of tropical trees.

Keywords: community phylogenetic structure, community assembly, competition, environmental filtering, habitat associations

11:20 Testing the phylogenetic structure of local communities: which null model is adequate?

Olivier J. Hardy
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Analyzing the phylogenetic structure of natural communities may illuminate the processes governing the assembly and coexistence of species in ecological communities. Different statistical tools were recently proposed to test such community-wide phylogenetic patterns, based on the phylogenetic clustering or overdispersion of the species in a local community. This provides a much needed framework for addressing

oldstanding questions in community ecology as well as the recent debate on community neutrality. The testing procedures are based on (1) a metric measuring the association between phylogenetic distance and species cooccurrence, and (2) a data set randomization scheme providing the distribution of the metric under a given null model. To verify the reliability of these approaches, I tested their statistical properties against simulated datasets devoid of phylogenetic structure regarding the spatial distribution of species. These datasets were obtained by simulating a locally neutral subdivided community that could include dispersal limitation and/or a phylogenetic signal in the species overall abundances. The consistency of type I error rates of tests based on several metrics combined with different null models was checked. This study shows that the approaches published so far can lead to liberal tests (i.e. tests rejecting the null hypothesis too often) under particular but important conditions. This may occur, for example, when species abundances are distributed non-randomly in space or across the phylogeny. Although no test was found valid in all conditions, some testing procedures are much more robust than others, in particular using two new metrics. The bad performances of several tests that have been used in previous studies might call for a reexamination of the evidence.

Keywords: community phylogenetic structure, neutral model, null models, randomization tests, type I error rate

11:40 Phylogeny, niches and relative abundance

C. K. Kelly and **M. G**. **Bowler**
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Community structure refers to the number of species in a community and the pattern of distribution of individuals among those species. We use a novel way of representing community structure to show that abundance within closely related pairs of co-occurring tree species in a highly diverse Mexican forest is more equitable than is abundance within more distantly related pairs. This observation falsifies the fundamental assumption of neutral models of community structure, that species are interchangeable, while simultaneously showing the significant impact of non-neutral (stabilizing) processes at the level of the community. Comparison with appropriate models further establishes that species are not interchangeable even within closely related pairs, signifying that relative abundance within such pairs is not simply a function of ecological similarity. The observed patterns instead indicate niche apportionment regulation of relative abundance by competition operating within compartments in which interaction is focused pairwise between congeners but falls away from the phylogenetic structure above the genus level. Niche processes thus significantly affect community structure through regulating relative abundance in a substantial proportion of species, which in turn potentially enhances community stability. We develop an analytical description of the observed pattern of relative abundances using temporal niche dynamics in which otherwise similar species exploit resource fluctuations over time rather than space, a mechanism by which competitors may stably coexist. One such mechanism of stable coexistence has already been shown to be active in this forest.

keywords: community structure; fractional abundance; stable coexistence; hierarchical niches; differential sensitivity storage dynamics; temporal niches

Spatial diversity in tropical plant communities: theory and data

12:00 **Jérôme Chave**
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Theoretical models of species-rich communities have recently made much progress in relating models to data, beyond simple curve-fitting exercises. In this paper I will present approximate statistical inference methods that can be used when the study model is not as easily analytically tractable as Hubbell's neutral model of biodiversity. These methods are of broad relevance in biostatistics and I will use them to estimate the parameters of a dynamic model of forest community.

Keywords: model, statistical inference, community

7 TROPI-DRY Part II: Human and Biophysical Dimensions of Neotropical Dry Forests: Results from a Collaborative Research Network

TUESDAY JULY 17
Room 5: Aula Mater (First Floor)
Building:Colegio Primitivo de San Nicolás de Hidalgo

Organized by:

- G. Arturo Sanchez-Azofeifa, Tropi-Dry Principal Investigator, Earth and Atmospheric Sciences Department, University of Alberta, Canada
- Mauricio Quesada, Centro de Investigaciones en Ecosistemas, Universidad Nacional Autonoma de Mexico
- Geraldo Wilson Fernandez, Biology Department, Universidade Federal de Minas Gerais, Belo Horizonte, Minas Gerais
- Jon Paul Rodriguez, Instituto Venezolano de Investigaciones Cientificas (IVIC), Caracas, Venezuela

10:00 Vegetation and flora of Central Brazil dry forests and the strategy for its conservation

Anderson C. Sevilha, **Taciana B. Cavalcanti**, and **Aldicir Scariot**
Embrapa Recursos Genéticos e Biotecnologia, Brasília, DF; Brazil
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Brazilian seasonally deciduous forests – a type of dry forest - cover 7,367,815 ha (3.21% of Brazil). Until now, only 117,980 ha (0.43%) have been incorporated in conservation units of restricted use as national parks and biological reserves. Paranã River Valley (PRV) is located in Central Brazil Cerrado, embedded in a transition zone between the wet Amazon and the semi-arid Caatinga Biomes. This region presents a mosaic of vegetation types from typical savannas to seasonally forests formations, and has some of the last remnants of deciduous forests in Brazil. Nevertheless only one 2,000 ha conservation unity is fully implemented in PRV. Since 1999 we develop a project in the region which resulted in: a) remnants vegetation detection; b) biodiversity inventories by RAP (Rapid Assessment Program) methodology; c) identification of priority areas for conservation, and d) expansion and reintroduction of endangered tree species populations. We recorded 1,106 plant species in 118 families (10% and 70%, respectively over the total estimated for Brazilian Cerrado), including 31 threatened and endangered species. Considering only the dry forest formations we found 128 tree species in 90 genera and 41 families. We used Multivariate analyses (ordination and classification) to assess both the floristic uniqueness of the woody vegetation of deciduous forests in PRV in relation to other regional vegetation types, and to other deciduous forests. The results indicate the existence of two dry forests subtypes of deciduous forest, distinct from all savannas formations. From 128 species sampled,

44.5% were restricted to calcareous soils on the flat lands, 15.5% to limestone outcrop and 40% were common between both types. This emphasizes the necessity of taking into account the principle of complementarity in conservation planning of these dry forests.

Keywords: Brazil, Tropi-Dry, Tropical dry forests, ecosystem composition

10:20 Linkages between ecosystem structure, composition and leaf area index along a tropical dry forest chronosequence in Mexico

Yingduan Huang[1], **Arturo Sanchez-Azofeifa**[1], **Benoit Rivard**[1] and **Mauricio Quesada**[2]
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[2]Centro de Investigaciones en Ecosistemas, Universidad Nacional Autónoma de México
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The objective of this study was to compare the phenological characteristics among three successional stages (stage of regeneration): early, intermediate and late stage, using leaf area index (LAI; the amount of total leaf area per unit ground surface area) measured by optical methods, in a tropical dry forest in Mexico. Three of nine 30m*60m plots were set up for each successional stage. Leaf area index and woody area index (WAI; the contribution of woody components of the canopy) were measured, and were interpolated to create a surface for each plot. Leaf area index was then calibrated by subtracting WAI. The paired t-test was used and significant increase was found in: (1) LAI of most plots from July to August ($p<0.05$); (2) LAI of each successional stage from July and to August ($p<0.01$); (3) LAI of three successional stages from July to August ($p<0.0001$). The independent t-test was carried out to compare WAI/LAI between the three successional stages. The late stage was found to have the highest WAI followed by the intermediate and early stage ($p<0.1$), while the intermediate stage was found to have the highest LAI in July and in August respectively followed by the late and early stage. The highest LAI in the intermediate stage can be explained by the species composition, where lianas were found other than in the early and late stage. Difference of LAI also exists within each successional stage. Higher LAI was found at Caiman for both early and intermediate stage, and at Gargollo for the late stage. This can be explained by the difference in elevation of each site. The average elevation (above sea level) at Gargollo is about 50 meters lower than the other two sites of the late stage, and the two sites at Caiman are 30 to 115 meters lower than the others.

Keywords: Mexico, Tropical Dry forests, Tropi-Dry, Leaf Area Index (LAI).

10:40 Mass loss and nitrogen dynamics of decomposing leaf litter of 26 tropical dry forest species: a trait-based approach

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The decomposition of leaf litter is a major pathway by which nutrients are returned to the soil, and constitutes a significant flux of carbon dioxide to the atmosphere. The chemical and physical properties of leaves are a major determinant of the rate at which litter decomposes. Dry tropical forest plant species have a large diversity of phenological strategies from evergreen to deciduous, and thus potentially large gradients in leaf chemical and structural properties. In this study we examined the patterns of variation in leaf traits from 26 co-occurring species in a tropical dry forest and the consequences of this variation for litter decomposition and nitrogen release. Our specific questions were, i) how do leaf chemical and physical properties vary among a diverse sample of dry forest plants?, ii) are there correlations among chemical and physical leaf traits, foliar nutrient dynamics and decomposition rates and nitrogen dynamics? Chemical traits (lignin, nitrogen, and phosphorus concentrations) of fresh and senesced leaves varied by functional group when plants were categorized as evergreen, deciduous or legumes. However, leaf physical traits (leaf toughness and specific leaf area (SLA)) and nutrient resorption did not vary among functional groups. There were significant correlations within pairs of physical or chemical traits (i.e. SLA was negatively correlated with toughness and litter N correlated positively to litter P), but there were no significant correlations among pairs of chemical and physical traits. Decomposition rates in litter bags set out at the beginning of the wet season were very rapid, with some species losing 35% mass in the first two weeks. Of all the foliar traits measured, lignin:N best predicted short-term decomposition rates. These data suggest that it may be possible to represent ecosystem functions of the vast diversity contained with tropical dry forests with relatively simple relationships in ecosystem simulation models.

Keywords: Costa Rica, Tropical dry forests, Tropi-Dry, leaf traits

11:20 Ecological Basis for the Conservation and Management of Endangered Dry Forests Trees in Central Brazil

Aldicir Scariot[1], Daniel L. M. Vieira[2], Anderson C. Sevilha[1], Alexandre B. Sampaio[3], Antonieta N. Salomão[1] and **Ernestino Guarino[1]**
[1]Embrapa Recursos Genéticos e Biotecnologia, Brasília, DF; Brazil
[2]Embrapa Tabuleiros Costeiros, Aracaju, SE; Brazil
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Two of the most economically important tree species in Brazil, *Amburana cearensis* (Leguminosae – Papilionoideae) and *Cedrela fissilis* (Meliaceae), had their populations heavily logged and are now classified as endangered. Both species were abundant in the Central Brazil Dry Forests, occurring in rich soil patches. The abundance of timber trees on rich soils attracted attention of farmers who logged the forests, and replaced them by large extensions of pastures covered by exotic grasses. The last populations of these species are now restricted to the small (generally < 250 ha) fragments, which have also been subjected to different logging intensities, resulting in low population densities of both species. The challenge is now to recover and to expand these species populations. In the Paranã River Valley (60,000 km^2), in Central Brazil, we mapped the potential distribution of both species using species presence based on tree sighting, topographic,

soil and geology maps. Higher prediction of species occurrence is restricted to the small parts of the Valley with high fertility soils and flat terrain, which are the most devastated by agriculture. To generate information to increase the success of population reintroduction and management, we studied both species population structure, resistance to fires, seed germination, soil seed bank, seed predation, seedling establishment and growth in tree gaps and under closed canopy in logged and intact fragments. Fire seems do not affect plant survival. Both species do not form soil seed banks. For restoration by direct seeding, seeds should be collected during their seed dispersal period and stored until the beginning of the rainy season. Seeds need protection against predation by vertebrates and insects. Higher survival is achieved when seedlings are planted in shaded areas, although growth is increased in tree gaps.

Keywords: Brazil, tropical dry forests, endangered tropical trees

11:40 Human dimensions of land use and land cover change around the Chamela-Cuixmala Biosphere Reserve

Alicia Castillo
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For more than 30 years, a high number of biological and ecological studies have been conducted at the site where the Chamela-Cuixmala Biosphere Reserve is located. Since the year 2000, we have been conducting investigations aimed at understanding several social aspects in relation to the human communities that live in the area adjacent to the reserve. One of our central interests has been to work with “ejidos”, the main tenure and rural organization system present in the area. We have documented an environmental history of the region and some local histories of the “ejidos”, as well as the perspectives of “ejidatarios” regarding issues such as the presence of tropical dry forest, its use, its transformation for developing agricultural and cattle raising activities and its conservation. Our analysis has also included the examination of governmental policies, particularly environmental conservation efforts. In recent years, we have obtained information about “ejidos” viewed as local institutions in order to understand their functioning and their collective actions. As part of the tropi-dry project, we are collecting data in an “ejido” which area is bigger than that of the reserve and which productive activities include agriculture, cattle raising and forest exploitation. Combining the remote sensing data collected by the tropi-dry team, and the conduction of qualitative interviews and participatory workshops with “ejidatarios”, our aim is to analyze from an historical point of view the social drivers that could explain land use and changes in land cover. To understand the role of agricultural and environmental policies in these processes is a fundamental aim in this research.

Keywords: Mexico, Tropi-Dry, tropical dry forests, land use/cover change, Chamela

12:00 Deforestation and restoration of tropical dry forest: the case of the Chorotega Region in Costa Rica

G. Arturo Sánchez-Azofeifa[1], Julio C. Calvo-Alvarado[2,] Alexander Pfaff[3] and **Juan Andres Robalino[4]**
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One deforestation 'hot spot' in Costa Rica during 1950-1960 was the Chorotega region, better known as Guanacaste province. After 1960, however, the region's forest-cover change featured significant regeneration of tropical dry forest. Using remote sensing, GIS and econometric analysis, this paper tracks the evolution of forest in the region as well as the role of one conservation policy during a recent segment of that history. By the late 1960's the region had ~37% forest cover. This stock had fallen to 23% in 1979 but rose steadily for over two decades to 34% in 1986, 42% in 2000 and 52% in 2005. For 1960 to 1979 the annual deforestation rate was 2.76% per year while for 1979–1986 and 1986–2000 the forest was restored instead, at a rate of 1.63% and 4.91% per year. Prior work finds that given other conservation policies and economic trends, the deservedly famous Payments for Environmental Services program (or PSA in Spanish) had very little impact on deforestation rates across the country. It was slightly greater for 2000-2005 than for 1997-2000 (the first few years of the program), in large part due to a higher (though still low) background rate of deforestation. Given our interest in the tropical dry forest, for Guanacaste alone we replicate prior econometric analysis of PSA impact on 1997-2000 deforestation in Costa Rica. We find any impact to be statistically insignificant. Such empirical evaluation aids any effective future science-policy nexus.

Keywords: Costa Rica, Guanacaste, Tropi-Dry, tropical dry forests, econometric analysis

8 Part II Managing Tropical Agricultural Landscapes to Enhance Biodiversity

TUESDAY, JULY 17
Room 1: Teatro José Ruben Romero
Bulding: Teatro José Ruben Romero (Auditorium)

Organized by:
- Robin L. Chazdon, Dept. of Ecology and Evolutionary Biology, University of Connecticut

14:00 Sustaining the genetic diversity of trees in managed landscapes

David Boshier, **Tonya Lander** and **Paul Rymer**
Oxford Forestry Institute, Department of Plant Sciences, University of Oxford
Email: david.boshier@plants.ox.ac.uk

Forest conversion to agriculture and other uses has dramatically reduced tropical forest cover and left much forest as highly fragmented patches, with consequent impacts on population sizes. A high proportion of tropical tree species appears to be naturally outcrossing, with associated risks from inbreeding and small populations. Thus maintenance of genetic diversity is vital for long term viability and adaptability of populations. Fragmentation studies are dominated by neutral matrix and isolation by distance models. Landscapes are viewed as islands, containing the only functional habitat, surrounded by a homogenous matrix or hostile sea of non-habitat. The matrix is only a distance to be crossed, with decreasing gene flow between island populations as distance increases. A number of studies suggest that for many populations and individuals of tropical trees, gene flow may be high across managed landscapes with little forest cover. Trees in a range of agroecosystems may therefore play an important role in the long term genetic viability of many tree species through; facilitation of gene flow between existing reserves, conservation of particular genotypes not found in reserves and/or the maintenance of minimum viable population numbers, provision of habitat that facilitates gene flow in other tree species. Managed landscapes may, however, vary in the degree to which they present a barrier to, or facilitate, gene flow, depending on the ecological requirements of the organism and the ecological attributes of the matrix. This may have significant implications for the way habitat corridors and biological reserves are conceived of and designed as well as our ability to simultaneously manage landscapes for conservation, economic and social value.

Keywords: fragmentation, landscape matrix, gene flow: corridors

14:20 Predicting the forest regeneration capacity of post-agricultural tropical landscapes

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Post-agricultural secondary forests are an increasingly important part of tropical landscapes, and their rates of regeneration are quite variable. We develop a simple model to predict how the rate of regeneration should vary with previous land use. The model is based on two major independent variables, the availability of propagules and site quality, which interact to determine the rate of regeneration of woody plant biomass. Comparing among land use types, the model predicts lowest rates of regeneration for pastures and highest for agroforestry and shifting cultivation. The model also predicts how rates of biomass regeneration should vary within a land use type, depending on variables such as the temporal and spatial extent of agricultural use. A review of the data available indicates that the model is quite successful in predicting both between- and within-land-use-type differences in biomass regeneration rates. It can be extended to predict other important aspects of regeneration, such as recovery of biodiversity and rate of re-establishment of late-successional species.

Keywords: biodiversity, ecological restoration, ecological succession, seed dispersal, shifting cultivation

14:40 Spatial patterns of tropical forest recovery in an agricultural landscape

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Increasingly, large areas of post-agricultural land are becoming available for restoration in the tropics. A better understanding of spatial patterns of tropical forest recovery is needed in order to allocate limited restoration resource. We initiated a large-scale restoration study: 1. to test planting tree islands of different sizes (applied nucleation) as compared to planting the entire plot with trees (plantation), or control no planting; and 2: to evaluate the relative importance of the amount of forest cover in the surrounding landscape on forest recovery. During 2004-2006 we established 16 sites across a >100 km2 in southern Costa Rica. Each site has three 0.25 ha plots with one of the three treatments and are surrounded by a forest cover range <5-50%. Thus far, we have recorded tree seedling survival rates of 75-95% for the four species, and growth rates of 0.5-1.5 m per year. Only two years after treatment establishment we have recorded strong effects on the number and types of birds using the restoration plots. During November 2006, 0.7, 1.2, and 1.7 individuals and 0.5, 0.7, and 1.1

species were captured per net hour in the controls, islands, and plantations in 2-yr old sites, respectively. Birds were more likely to visit larger tree islands. We have started detailed measurements of seed rain and seedling establishment, and will monitor vegetation and dynamics of bird use in these plots over the long term in order to inform tropical forest restoration efforts.

Keywords: restoration, Costa Rica, succession, landscape ecology

15:20 Restoring tropical forest biodiversity using late-successional tree species

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Fragmentation of tropical forest is accelerating at the same time that already cleared land reverts to secondary growth. Early-successional environments are low-diversity stands of the few species that are able to arrive (i.e., pioneer trees). Planting non-pioneer species may help to bypass this low-diversity stage by overcoming dispersal limitation. Non-pioneer species will also provide a variety of food resources for animals that will reestablish normal processes of seed dispersal into and out of the fragments. To develop criteria for selection of non-pioneer species that perform best in early-successional environments, we followed 24 non-pioneer species growing in an experimental plantation near the Los Tuxtlas Biological Station in Veracruz, southeast Mexico. We measured the growth and survival of these species together with their morphological and demographic leaf traits under the different microhabitat of early successional environments: dark understory of the secondary forest, edges and open pastures. We found that the best criteria for selection of species are plasticity in leaf mass per unit area, leaf survivorship, and leaf production. High plasticity in leaf mass per unit area is a powerful tool for selecting mid-canopy species with potentially higher growth rates and survival across the microhabitats of early-successional environments. High plasticity in leaf survivorship in conjunction with homeostatic leaf production also led to higher survival and growth rates in early-successional environments. Use of variability in morphological and demographic leaf traits and other indices (e.g., maximum mature height) that are related to performance may alleviate the need to individually screen large numbers of non-pioneer species for restoration projects. Use of such easily assessed measures would free time and resources for evaluation of other criteria, such as economic value or dispersal attributes that influence animal populations. Enrichment of early successional environments that includes as many species as possible will maximize diversity and complexity of regenerating forests.

Keywords: Functional leaf traits, late-successional trees, Los Tuxtlas, Restoration Ecology, SLM

15:40 The fate of dry Afromontane forests in northern Ethiopia

Frans Bongers[1], **Alemayehu Wassie**[1], **Raf Aerts**[2], **Tefera Mengistu**[3], and **Frank Sterck**[1]
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[2]Katholieke Universiteit Leuven, Division Forest, Nature and Landscape
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Dry afromontane forest in Northern Ethiopia are heavily deforested and fragmented, and currently only small, isolated patches of forests remain in a matrix landscape of mainly agricultural land. For long-term preservation of these forests effective protection is highly needed, and restoration activities are necessary to improve quality and possibly extension of the forested area into the agricultural matrix. In this paper we analyse the deforestation patterns, the current situation of the remaining forest patches and a number of possible restoration measures. The data come from a number of detailed studies in the area. Current levels of forested area is between 1 and 5% and deforestation rates are high, sometimes 30% in 30 years. Most forest patches remain in areas around churches. These forests typically are small, in most cases smaller than 10 ha. The forests harbour relatively large numbers of species but population sizes generally are small. Also, species composition is rather different from forest to forest. General threats to these forests are agricultural intrusion into the forest area, selective cutting of trees and extensive grazing. Restoration efforts in and around these forests, in the form of enrichment planting (seeds or seedlings), and soil management show that restoration is possible. Germination, growth and survival of selected species is good. Shrubs can act as nursery plants for tree seedlings. However, it is crucial that grazing animals are kept out of experimental restoration plots. This is also shown by larger scale enclosures where animals are not allowed to enter the enclosed area. Vegetation cover generally establishes relatively quickly. Enclosures as such provide good opportunities. Attention will be given also to peoples attitudes towards restoration measures. We will present and discuss the results of these studies and their possible application for larger scale restoration
efforts in these afromontane forest areas.

Keywords: afromontane forests, restoration, forest islands, forest conservation, Ethiopia

16:00 Structural and functional dynamics of second-growth forests under contrasting previous land use regimes: a long-term permanent sample plot study in Northeastern Costa Rica

Robin L. Chazdon[1] and **Bryan Finegan**[2]
[1]University of Connecticut
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We describe temporal dynamics in tree community structure and functional composition in eight permanent monitoring plots (PMP) in second-growth rain forests of NE Costa Rica. Four plots that were cleared and used for pasture for several years (PP) were monitored annually for 10 yr, whereas four plots that were cleared, planted briefly, and then abandoned (Light use plots, LUP) were followed at irregular intervals for 19 yr. Seven plots were initially 12-25 yr post-abandonment (the older plots); one LUP was initially 1 yr old. We evaluated functional composition using a classification of five plant functional types (PFTs) developed by cluster analysis of tree species described by two traits, height range (H) reached by adult trees and absolute annual diameter growth rate (AGR, five categories, from long-term PMP

data in logged mature forests of the study area). Stand density ≥10 cm DBH (N) showed highly variable spatial patterns and temporal dynamics within and among plots. Stand basal area (G), in contrast, was closely related to initial stand age (R2 = 0.79), and increased consistently over time in all plots. Previous land use did not affect dynamics in N or G. Stand density for PFT-1 (understory tree species) and PFT-2 (slow or very slow-growing mid-canopy species) was generally lower in PP than LUP plots. PFT-5 (canopy and emergent tree species with moderate to very fast growth) was the most abundant type, largely accounting for dynamics in stand G and G increment. PFT-4 (slow or very slowgrowing subcanopy and canopy species) increased in G over time. PFT-5 was over-represented in both N and G in secondary stands compared to mature forest, whereas other PFTs were underrepresented. Our analysis suggests that second growth forests may differ more from mature forest in functional than taxonomic composition of trees.

Keywords: agricultural landscapes, land use, plant functional types, secondary forest, vegetation dynamics

11 Conservation of the Biodiversity and of the Environmental Services of the Forest: Basis for the Sustainable Development of the Amazon

TUESDAY, JULY 17
Room 4: Sala Rectores (Second Floor)
Building: Centro Cultural Universitario

Organized by:

- Regina C. C. Luizão, Scientific Coordinator of the Biological Dynamic of Forest Fragments Project - BDFFP. National Institute for Research in the Amazon

The symposium "Conservation of Biodiversity and Environmental Services of Tropical Forest: A Basis for Sustainable Development in the Amazon" is designed to present the conception and main findings of a research network sponsored by the Pilot Program for Tropical Forest Conservation, among others. Based on the principle of keeping the forest standing for conservation purposes, the network seeks alternatives to deforestation and the overexploitation of the natural resources in the Amazon. The main aim of the research network is to evaluate how these processes can be changed to provide a better future for the local population and, simultaneously, keep the natural ecological functions of the ecosystem. The network is composed by five projects working on the quantification and valuation of the environmental services offered by the Amazon forest for human well being as an essential part of regional development. The network is linked to the Biological Dynamics of Forest Fragments Project (BDFFP), which is a cooperative study between the National Institute for Research in the Amazon (INPA) and the Smithsonian Institution. Most of the network's research is taking place at BDFFP sites. The symposium is intended to show the main results so far and the perspectives for reversing the current model of land use in the region, which is inefficient and socially unfair in benefiting only a local minority.

14:00 Learning from a long-term study of forest fragmentation and conversion in central Brazil: BDFFP insights and highlights

Regina C. C. Luizão
Dept. of Ecology, INPA
Biological Dynamics of Forest Fragments Project (BDFFP)- National Institute for Amazonian Research (INPA), Manaus, Brazil

The Biological Dynamics of Forest Fragments Project (BDFFP), founded in 1979 by Thomas Lovejoy as the Minimum Critical Size of Ecosystems Project focused on assessing fragment area related to changes in rainforest communities with the idea of testing how large would reserves need to be to ensure the survival of Amazon forest species into the next century. BDFFP researchers have been working to answer these questions ever since, and the project is now one of the world's largest and longest-running ecological projects with activities far more diverse. Currently it also includes a complex and sophisticated range of studies designed to assess the role of edge, area, isolation, and matrix effects on plant and

animal communities; autecological investigations of key species; diverse studies of forest regeneration; spatial modeling of land-use changes throughout the Amazon basin; studies of aquatic ecosystems; and long-term investigations of ecological changes in old-growth forests and its biodiversity. Concomitantly education and training has played a major role in the project's mission and have influenced the conservation policies in Amazonia, via its publications and capacity building. As a model of international cooperation, long-term scientific study, and research and training, the BDFFP has and will continue to make important contributions to our

14:20 Loss of environmental services from deforestation in Brazilian Amazonia: Impacts of the Manaus-Porto Velho (BR-319) Highway

Philip M. Fearnside, Graça Paulo Mauricio Lima de Alencastro, and **Willem Hermanus Keizer Edwin**
Instituto Nacional de Pesquisas da Amazonia (INPA)
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Deforestation in Brazilian Amazonia replaces tropical forest with a landscape dominated by cattle pasture, together with smaller percentages of secondary forest and agriculture (including large areas of soybeans in some areas). This transformation causes loss of environmental services of the standing forest, such as maintenance of biodiversity, water cycling and carbon stocks. The BR-319 Highway linked Manaus, in the state of Amazonas, to Porto Velho, Rondonia, until it became impassable in 1988. Now the BR-319 is proposed for reconstruction and paving, which would facilitate migration from the Arc of Deforestation in the southern part of the Amazon region to new frontiers farther north. The lack of a land connection to Manaus currently represents a significant barrier to migration to central and northern Amazonia. Preliminary models attempt to quantify the highways likely effect on deforestation and consequent loss of environmental services, especially carbon stocks.

Keywords: Amazonia, Brazil, Deforestation, Highways, Roads

14:40 Biogeochemical functioning of intact forest and altered ecosystems in Central Amazon: loss and rehabilitation of environmental services at a local scale

Flávio J. Luizão [1] and **Regina C.C. Luizão**[1,2]
[1]Dept. of Ecology, National Institute for Research in the Amazon (INPA), Manaus
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This study is focused on the identification of changes in the forest functioning triggered by the deforestation and replacement by cattle pastures, as well as the processes of the recovery of the second growth after the abandonment of the pasture. Two small scale catchments are under controlled monitoring for both soil and hydrological processes, one in intact forest and other in impacted area. Recovery of the stream that is running from the pasture into the second growth and mature forest is pretty good because: (i) it runs for only a

short while in the pasture, soon entering into the forested area; (ii) at the stream edges, a strip of the original forest was preserved, protecting the water body from the impacts of the former pasture which covered most of the area and lasted for ca. 10 years. A litter decomposition experiment conducted at the stream waters showed that only the density of the collector-gatherers has changed significantly from the beginning of the water body towards a 300-m downstream point. Leaf litter falling into the stream appears to be important hiding places for the invertebrate animals in the stream, and thus a key resource for the functioning of the system.

15:20 Disrupted ecosystem functioning in Amazonian forest fragments

William Laurance
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Rainforest fragmentation alters important ecosystem attributes in Amazonian forests, such as forest dynamics, carbon storage, nutrient cycling, and species composition. I summarize results of a 24-year study of tree and liana communities in fragmented and intact Amazonian forests, emphasizing changes on carbon storage and dynamics. One of the principal drivers of ecological change in fragmented rainforests is sharply increased tree mortality, mainly caused by microclimatic stresses and increased wind turbulence near abrupt forest margins. As a consequence, fragmented forests experience accelerated forest dynamics and tree-species turnover, a decline of live biomass, proliferating lianas, and surprisingly rapid changes in tree-species composition. Carbon storage declines in fragments for three reasons: because tree mortality is elevated, because many of the trees that die are large, and because fast-growing species with low wood density (and hence low carbon storage) are favored at the expense of slower-growing species with higher wood density. In addition, less carbon is stored in long-lived trees in fragments, and more carbon in wood debris, litter, and short-lived plants, leading to accelerated carbon cycling. Finally, fragmented forests are often drastically more vulnerable to fire than are intact forests.

Keywords: Ecosystem processes, edge effects, forest fragmentation

15:40 Studies on conservation and use of forestry resources: natural history of tropical trees, seed technology and seedling propagation

José Luís Camargo
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This set of studies is part of a large network and may be important to guide the use of forest resources in a sustainable way. Three main targets will be emphasized: 1) to discover some aspects of the natural history of abundant tropical trees and how forest fragmentation may change their reproductive phenology; 2) to carry studies on seed storing technology and 3) to improve techniques of seedling's propagation for economically import tree species to

provide more options to enrich degraded lands or secondary forests. Part of the information gathered in these studies was used to elaborate the first volume of the Amazonian Propagules & Seedlings Guide. The dissemination of these results may help people to adopt new practices to conserve forestry resources *in situ* and *ex situ*.

16:00 Ecological succession in degraded areas of the Central Amazon: processes, causes and consequences

Rita Mesquita[1] and **Tony Vizcarra Bentos[2]**
[1]Adjunct Secretary for the Environment and Sustainable Development, Amazonas State Government, SDS, Manaus, Brazil
[2]Biological Dynamics of Forest Fragments Project, National Institute for Research in Amazonia (INPA), Manaus, Brazil
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It is a well known fact that the systems of land occupation fostered by governmental agencies, such as the typical rural settlements of Incra, or the colonization projects of Suframa in the Amazon have failed to sustain productive activities. Rural settlers either lack the necessary profile to survive and make a profit out of field cultivation, or are abandoned to their own luck when it comes to designing the productive systems adapted to the local conditions. Our study evaluates the dynamic of the second growth vegetation in an agricultural landscape of Central Amazonia, and will contribute for the land use models for the region. Also, by focusing on farmers economic and agronomic decisions, and by evaluating their failures or successes, we expect to build a field tested model of use of the second growth in the recovery of degraded land, landscape rehabilitation and the restoration of environmental services. At this phase of the project, we have interviewed 42 farmers and family agriculture workers, of 5 different settlements. The majority has only elementary schooling, and technical assistance is scarce to non-existent. Their plots are on average 25 ha each, have had 20% of its area deforested and cultivated, and are planted with over 30 different crops and fruiting trees, charcoal and wood being the principal sources of energy. 50% of the properties receive money from external sources to supplement their needs (most retirement and other public sources); only 17 owners belong to some form of organized association. Very little of what is produced ever makes it to the market, subsistence agriculture and temporary or seasonal products being the rule. On average, more land is abandoned as second-growth than on active cultivation at a given time, and fruit gardens and orchards occupy as much land as crops and other cultivated fields. Clearly, the current owners do not have agriculture as their main income source, and are testing a diversified set of cultivation systems. By aggregating scientific knowledge with the empiric knowledge of the rural people we expect to be able to build more robust and profitable cultivation systems for the region.

7 TROPI-DRY Part III: Human and Biophysical Dimensions of Neotropical Dry Forests: Results from a Collaborative Research Network

TUESDAY, JULY 17
Room 5: Aula Mater (First Floor)
Building:Colegio Primitivo de San Nicolás de Hidalgo

Organized by:

- G. Arturo Sanchez-Azofeifa, Tropi-Dry Principal Investigator, Earth and Atmospheric Sciences Department, University of Alberta, Canada
- Mauricio Quesada, Centro de Investigaciones en Ecosistemas, Universidad Nacional Autonoma de Mexico
- Geraldo Wilson Fernandez, Biology Department, Universidade Federal de Minas Gerais, Belo Horizonte, Minas Gerais
- Jon Paul Rodriguez, Instituto Venezolano de Investigaciones Cientificas (IVIC), Caracas, Venezuela

14:00 Natural regeneration and restoration of dry forests of Central Brazil

Daniel L. M. Vieira[1], Alexandre B. Sampaio[2], Aldicir Scariot[3] and **Anderson C. Sevilha[3]**
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We studied some aspects of natural regeneration of dry forests and used the gathered information to test methods to facilitate the recovery of these forests in disturbed areas. Seed germination and seedling establishment are limited by the highly variable precipitation and frequent dry spells. Experiments testing the effect of timing of seed dispersal – natural (dry season) × delayed (rainy season) – on seed germination and seedling establishment showed that for three out of eight studied species, dispersal during the rainy season increased seedling establishment. Thus, collecting seeds at the end of the dry season and planting when soil has sufficient moisture may increase seedling establishment for fast germinating seeds. Germination and early establishment are favored in shaded sites, which have milder environment and moister soil than open sites. Seedling survival of six out of seven studied species was lower in large gaps than in understory. In contrast, growth was much higher in gaps than in the understory of minimally disturbed forests. Clearing out the grass cover in pasturelands, also allowed a higher average increase in height of seedlings and saplings compared to control plots. Therefore, clipping undesired plants around established seedlings increase growth.

Resprouting ability after disturbance is a widespread trait among dry forest trees. This trait makes forest regeneration be high in recently established pastures, with high root sucker density and diversity. Tree species regenerating from root-suckers in pastures of varied age was only 20% lower than that found in the reference site (51 tree species), with a similar species composition. In a 25-yr-old pasture which was permanently grazed, mowed and plowed, 39 tree species were found resprouting from roots. Even in 40 year old pastures, constantly managed for maintain grass cover, there are suckers from many species.

Keywords: Brazil, tropical dry forests, Tropi-Dry, natural regeneration

14:20 The changing context of forest protection: investigating the influence of socioeconomic change on forest regrowth in the Guanacaste Conservation Area, Costa Rica

Blythe McLennan, Theresa Garvin and **Arturo Sanchez-Azofeifa**
Earth and Atmospheric Sciences Department, University of Alberta, Canada
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In general, forest regrowth in Costa Rica is primarily attributed to the success of government programs, in particular, establishing protected areas and introducing Payments for Environmental Services (PES). However, recent land-use/land-cover change research shows that broader socioeconomic factors also influence patterns of forest regrowth. While socioeconomic influences are included in the analysis of deforestation in Costa Rica, they are largely overlooked in examinations of forest regrowth. The research presented here examines the Guanacaste Conservation Area in north-west Costa Rica. Historically, extensive cattle-ranching was the primary land use in the Guanacaste region, leading to extensive deforestation. In recent years, however, the cattle industry has declined and significant forest regrowth has been observed. We investigated the socioeconomic factors that influence landholder decisions to abandon pasture and agricultural land to forest regrowth through a multi-scale qualitative study. First, we conducted an in-depth case study in one community using semi-structured interviews with a selection of landholders and people with critical knowledge of land use. Interview topics included social history, environmental perceptions, land use history and public policies. Second, the case study findings were presented to focus groups in other communities across the region and feedback was solicited on the similarities and differences in people's land use experiences. This study shows that forest regrowth on private land in the Guancaste Conservation Area is largely a result of socioeconomic change. While we do not suggest that forest protection programs in Costa Rica are ineffectual in promoting forest regrowth, we do suggest that their effectiveness has been overstated and that not enough attention has been given to the impact of socioeconomic factors. If forest protection programs are to be effective in the long term, they will need to respond to changes in socioeconomic conditions, or run the risk of becoming obsolete.

Keywords: Costa Rica, Guanacaste, Tropi-Dry, Human dimensions, forest protection

14:40

Changes in composition, structure, and diversity of phyllostomid bat communities during the natural regeneration of tropical dry forest

Luis Daniel Ávila Cabadilla and **Kathryn E. Stoner**
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Tropical Dry Forests are one of the most endangered ecosystems in the world. A great part of their original area has been fragmented and/or transformed into expansions of secondary vegetation representing different successional stages. Nevertheless, changes in faunal communities occurring during succession have been poorly studied. We compare the community of phyllostomid bats associated with different successional stages in the Tropical Dry Forest of the Chamela-Cuixmala Biosphere Reserve (Pacific coast of Mexico). Twelve sites representing four successional stages (pastures, early, intermediate and late) were sampled using 5 mist-nets once every 6 weeks during the period 2004-2006 (24 months). Species richness, diversity, as well as numbers of trophic guilds and numbers of species within trophic guilds, increased during the successional process, reaching a maximum in late stages. Bat communities associated with early and intermediate succesional stages contained the same species showing the highest similarity index. Several species of frugivores and nectarivores were only found in the mature stage. We observed that changes in species composition during succession fit an "additive" pattern, where the transition from one stage to the next was characterized by the addition of new species in the community, but no species loss. We conclude that bat species community structure may be a useful indicator of forest maturity.

15:20 Diversity of fruit-feeding butterflies on three successional stages of a seasonally dry tropical forest in northern Minas Gerais, Brazil

Bruno Gini Madeira[1,2], Elton Bordoni[3], Victor Hugo Fonseca Oliveira[1] and **Carlos Frankl Sperber[4]**
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[2]Pós-Graduação em Entomologia, Departamento de Biologia Animal, Universidade Federal de Viçosa, Viçosa-MG, Brazil
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We studied changes in fruit-feeding butterfly diversity along a successional gradient in a seasonally dry tropical forest in southeastern Brazil. The study was performed in the Parque Estadual da Mata Seca, Minas Gerais state (14°48'36" – 14°56'59" S and 43°55'12" – 44°04'12" W). Butterflies were sampled in 6 plots of 50 x 20 m (0.1 ha) at the early and intermediate successional stages, and in 8 plots in the late successional stage. We fitted four traps in each plot, two in the canopy and two in the understory, baited with mashed bananas fermented with sugarcane juice. Butterfly species richness did not differ between successional stages, contrary to predictions of ecological succession models. The lack of difference in butterfly species richness along the successional gradient is

discussed in relation to resource heterogeneity and butterfly dispersal capabilities. Individual abundance also did not differ between successional stages, suggesting that resource availability, for instance, might not play a role in determining butterfly population sizes. On the other hand, species richness and individual abundance were lower in the canopy than in the understory, indicating vertical stratification in butterfly community structure, and showing that sampling in more than one vertical position in seasonally dry tropical forests is fundamental for estimating butterfly diversity. Patterns in butterfly community composition and structure were compared to those recorded for other tropical forests in Brazil and the Americas, and implications for conservation are discussed. This is the first study that analyzed changes in butterfly structure along a successional gradient in seasonally dry tropical forests.

Keywords: Brazil, tropical dry forests, Tropi-Dry, fruit-feeding butterflies

15:40 Reproductive phenology and pollination ecology of Ipomoea in different successional stages in a dry tropical forest

Víctor M. Rosas-Guerrero*, Mauricio Quesada, Yunuen García-Rojas° and Pablo Cuevas-Reyes°

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The great abundance and diversity of the lianas of the genus Ipomoea under different successional stages of tropical dry forests can affect the maintenance and establishment of the plant communities under succession. In this work we studied the species richness and abundance, and the pollination system and floral phenology of Ipomoea species that occur at different successional stages. Data on flowering phenology and pollination in different successional stages are virtually inexistent. We also evaluated the variation in pollinator's assemblages of the tree Ipomoea wolcottiana on different successional stages. In the different successional stages we found five and six species of Ipomoea with specialist and generalist pollination systems, respectively. The most abundant species on the different successional stages shows generalist pollination. With the exception of I. hederifolia, the species with specialist pollination show a longer flower duration in comparison with the generalist species. The majority of the most abundant species in the early successional stages show a longer duration, while the most abundant species in the late successional stages showed a short duration. Our results do not support the hypotheses that species in late successional stage will primarily show a specialist-pollination system. However, in early successional stages the majority of the species shows generalist-pollination systems. We found more abundance and species richness in the intermediate and early successional stages as expect. There was more pollinator's richness and more functional groups of pollinators in I. wolcottiana in late successional stages than in early successional stages.

16:00 Sustainability of tropical dry forests: informatics needs in an interdisciplinary and multidisciplinary world

John Gamon[1] and **G. Arturo Sanchez-Azofeifa**[2]
[1]California State University – Los Angeles, Los Angeles, California
[2]Earth and Atmospheric Sciences Department, University of Alberta, Canada
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Achieving long-term sustainability of tropical dry forests environments requires the integration of knowledge across disciplines that in many cases do not talk to each other. In general comparative analyses done across the Americas have been discipline driven with little or no integration. In the context of the Tropi-Dry Network this presentation will evaluate the challenges of integrating remote sensing, ecology and human dimension information across the Americas as part of an effort to better understand the human impact on the long-term sustainability, conservation and ecosystem management of tropical dry forests located in Mexico, Costa Rica, Venezuela and Brazil. Any solutions to these challenges must also address the complex policy needs of multiple countries in an increasingly global environment. This presentation will explore these inter- and multi-disciplinary challenges, with a particular focus on the cyberinfrastructural and informatics needs for better data collection, assimilation, integration and interpretation.

Keywords: Tropi-Dry, tropical dry forests, informatics, cyberinfrastructure

12 Part I: Approaches To The Study Of Ecosystem Services Provided By Tropical Systems

WEDNESDAY, JULY 18
Room 1: Teatro José Ruben Romero
Bulding: Teatro José Ruben Romero (Auditorium)

Organized by:

- Patricia Balvanera, Centro de Investigaciones en Ecosistemas, Universidad Nacional Autónoma de México
- Helena Cotler, Instituto Nacional de Ecología, Mexico

Tropical ecosystems provide a variety of services that are crucial for the well-being of their local inhabitants and human societies around the globe. Yet, present rates of transformations of such systems threaten the sustained delivery of such services. Further understanding is needed on what services tropical systems provide, how, how much and where they are provided, who benefits from them, what are the consequences of management of tropical forests on their provision, and what socioeconomic and political factors drive such management. The goal of the symposium is to present a wide overview of the different conceptual and methodological approaches used at present for the analysis of ecosystem services provided by tropical systems and their maintenance. A variety of terrestrial tropical ecosystems, one aquatic ecosystem and connections to non-tropical ecosystems are surveyed. Approaches include multidisciplinary teams that seek to understand the tight interconnections between human societies, ecosystems and their services. Others analyze ecological processes associated to the delivery of particular services and their consequent spatial patterns. Others develop tools for economic valuation of ecosystem services, or contributed to the development of payment for ecosystem services schemes.

10:00 Integrating science, economics and people: forest ecosystem services in the Valdivian rainforest ecoregion

Christine N. Meynard, Lara Antonio, Laura Nahuelhua, Cristian Echevería, Daisy Núñez, Carlos Oyarzún, Jorge León, Eduardo Neira and **Doris Soto**
Núcleo Científico Milenio FORECOS, Universidad Austral de Chile, Chile

Forest ecosystems have traditionally been valued for their timber, which has a market price that is easy to estimate. However, forest ecosystems also provide services that are more difficult to associate with a market price. These include water purification, maintenance of natural oxygen and nutrient levels in streams, flood control, sequestration of carbon, and scenic beauty. These ecosystem services have a large influence on human activities such as salmoniculture, agriculture, human health and tourism among others. The Valdivian Rainforest Ecoregion (35°S-48°S), located in Southern Chile and western Argentina, is an area of high endemism and diversity and has been classified as one of 25 conservation priority areas worldwide. The temperate rainforests within this

ecoregion are essential to provide different ecosystem services, but these remain largely unmeasured and unvalued. Consequently, the benefits they provide are not considered into the decision making processes that ultimately determine forest management and conservation. Moreover, connecting science and economics, and translating them into policy making clearly requires a transdisciplinary approach focused on the integration of multiple disciplines with the goal of solving complex problems. Here we report the main achievements of a transdisciplinary research in the Valdivian Rainforest Ecoregion. We have studied the relationship between several watershed services and land use from local to regional scales using a variety of techniques. We show here that there is a clear relationship between land use type, stream flow characteristics and economic activities. The economic value of erosion control, recreation opportunities and water supply provided by native forests in different watersheds of the regions was also estimated. We demonstrate that research on ecosystem services facilitates communication between scientists, decision makers and other stake-holders. This creates bridges between the relevant groups and is more likely to create sustainable management and conservation practices and can promote strategies for sustainable development.

Keywords: ecosystem services, water, forest, economic valuation

10:20 Assessing the linkages between plant functional diversity and ecosystem services from the stakeholders' points of view

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The recent Millennium Ecosystem Assessment has identified key links between generalized ecosystem services and different components of functional biodiversity: both the most abundant plant functional attributes, and the range of these attributes in local ecosystems. On these general bases, our study goes one step forward to identify ecosystem services which are more specifically linked to the needs, perceptions and interests of different stakeholders. Here, we propose and test robust conceptual links tracing them back all the way to the local abundance and range of plant functional attributes. The links between stakeholder-specific ecosystem services and functional biodiversity will be assessed through a comparison of the main land-use trajectories affecting contrasting biomes in the Americas. By considering the distinct and potentially conflicting interests of different social actors in a context of rapid land-use change, our approach should contribute to a better definition of the ecosystem-service value of the land, and to viable regional conservation strategies.

Keywords: Ecosystem services, functional biodiversity, land use change, plant functional traits, socio-ecological systems, sustainability

10:40 The inadequacy of fisheries science, especially when applied to the tropics

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Many important fisheries in temperate, developed countries are seriously overfished and their ecosystems seriously impacted despite an enormous expenditure of money and scientific effort to understand and manage fisheries sustainably. The degradation of so many fish stocks is being caused mostly by human factors, including the open access regime, subsidies, use of discount rates, and especially the industrialization of fisheries. Nevertheless, fisheries science has focused almost entirely on the population dynamics of the large fish stocks that dominate fisheries in temperate zones. But, in fact, real fisheries are composed of three equally important subsystems, i.e. the fish stocks, the human societies exploiting them, and the natural supporting ecosystems. The importance of each varies greatly overtime and from one fishery to another. So, it seems obvious that most of our existing knowledge about fisheries is conceptually inadequate to promote their understanding and conservation. This problem is exacerbated in tropical, developing countries, which have imported the fisheries paradigm invented in developed countries. Not only are managers in the tropics not trained to understand all three components of fisheries, but they face additional problems unique to the tropics that are ignored by the traditional fisheries paradigm. These include the predominance of many fisheries with few individuals of many species, under-developed and largely ineffective management agencies, and the most rapidly industrializing societies on the planet. Consequently, most academic approaches and methods available to fisheries management have little practical utility in the tropics. This is extremely important because developing countries contribute up to two-thirds of the world's capture of fish. In view of these issues, we recommend that the three components of fisheries be given equal priority, and that fisheries be viewed as complex, heterogeneous systems dominated by dynamic human societies and their technologies.

Keywords: economics, ecosystems, developing countries, over-fishing, social

11:20 Payment for environmental services: a new way of doing biodiversity conservation

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Many ecosystem services, such as water and climate regulation or biodiversity conservation, are essential to human well-being, yet globally threatened by accelerated deterioration. Payments for ecosystem services (PES) are increasingly emerging as a complement or alternative to indirect and non-conditional conservation approaches. PES may be more cost- effective conservation tools, by tangibly valuing ecosystems services through direct payments to local land managers, in return for adopting land and resource uses that guarantee ecosystem conservation and restoration. Following an initial PES definition, this paper presents a description and analysis of PES schemes worldwide that aims to allow us to understand their logic, scope, and implementation requirements, in particular in relation to preconditions prevailing in developing countries. Our analysis

reinforces the viewpoint that PES constitutes a promising tool for global ecosystem conservation. Although the incorporation of biodiversity into PES schemes has so far been slow, these schemes have the potential not only to raise new funds for conservation, including from national budgets allocated to other environmental fields, but also to innovate field implementation by trying to "buy conservation" in a conditional way. Finally, biodiversity conservation is a service that tends to present clear synergies with other environmental services, so that 'bundled' PES schemes may often prove to be an effective strategy against continued ecosystem deterioration.

Keywords: Payment for environmental services, conditional payments, biodiversity, economic instruments for conservation, developing countries

11:40 Consensus building by means of mediated modeling with an approach on ecosystem services

Octavio Pérez-Maqueo[1], Miguel Equihua[1], Gabriela Vázquez[1], Maria Luisa Martínez[1], Adolfo Campos-Vazquez[1], Gonzalo Castillo[1], Edmundo Díaz Pardo[2], José García-Franco[1], Daniel Gleissert[1], Klaus Mehltreter[1] and **Lyssette Muñoz-Villers[3,1]**
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[2]Universidad Autónoma de Querétaro
[3]Universidad Autónoma Metropolitana, Programa de Doctorado en Ciencias Biológicas

The analysis and maintenance of ecosystem services faces two important challenges: First, to increase the understanding of the functional processes that provide and generate ecosystem services. Second, it is urgent to reach consensus on the evaluation methods that help preserve ecosystems and ecosystem services provided by them. The achievement of a comprehensive and objective communication between the stakeholders is highly relevant to face these challenges. In this study we hypothesize that the active participation of stakeholders during model building enhances this communication, and furthermore, those participating in model elaboration take possession of it and hence, the model becomes more reliable and useful. To test the above, we built several simulation models focused on ecohydrological services of tropical mountain forest. Participation of different areas of expertise was considered a proxy to stakeholder's intervention in the modeling process. The goals of the models were to identify and evaluate the most relevant variables that are necessary in order to guarantee ecosystem services provision, in this case water quality and quantity. The pros and cons of this approach are presented and several recommendations are suggested.

Keywords: modeling, ecosystem services, watershed

12:00 Interdisciplinary development of conceptual frameworks and methodological tools for the study of ecosystem services: the case of the Cuixmala River basin

Manuel Maass[1], Patricia Balvanera[1], Alicia Castillo[1], Marisa Mazari[2], Helena Cotler[3], Elena Lazos[4], Patricia Avila[1], Luis Miguel Galindo[5] and **José Sarukhán[2]**
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[5]Facultad de Economía, Universidad Nacional Autónoma de México

The Cuitzmala River Basin in the Pacific Coast of Mexico, in an ideal system to explore the socio-ecological factors determining ecosystems services. It is big enough (1,089 km^2) to incorporate large scale ecological and socio-cultural processes, including agro-pastoral systems in the upper part, and extended pasture fields and tourist resorts in the lower part of the basin. It is also small enough to evaluate, with reasonable detail, these processes. In the last 30 years, there has been intensive scientific research in the region, mainly in the Chamela-Cuitzmala Biosphere Reserve, which is a tropical deciduous forest LTER site. A first evaluation of the ecosystem services has been already conducted in the area, using the Millennium Ecosystem Assessment Protocol. Now, we are starting a multi-institutional project aimed at understand the main ecological and socio-cultural factors determining patterns of delivery and consumption of ecosystem services, and the benefits local people obtain from them. Specific objectives include: building an interdisciplinary research group to generate own conceptual and methodological frameworks to study ecosystem services in the region; identify ecological and social factors determining patterns of both delivery and consumption of ecosystem services; elaborate possible future scenarios of ecological or social changes in the region; model possible consequences of theses scenarios in the pattern of delivery / consumption of ecosystem services; evaluate the perception of local stakeholders and users about the existence and their dependence of the ecosystem services; and assess their willingness to protect theses ecosystem services. Preliminary information from the project will be presented.

13 Debating the Tropical Extinction Crisis

WEDNESDAY JULY 18
Room 2: Conservatorio de las Rosas (Auditorium)
Building: Conservatorio de las Rosas

Organized by:

- William F. Laurance, ATBC Past-President, Smithsonian Tropical Research Institute, Balboa, Panama
- S. Joseph Wright, Smithsonian Tropical Research Institute, Balboa, Panama

A strident debate has erupted in the field of conservation biology. On the one hand is the traditional view, espoused by scientists such as Peter Raven, Stuart Pimm, William Laurance, and others, that suggests that rampant tropical deforestation is driving a mega-extinction crisis that, if unabated, might ultimately rival mass extinction events in earth's geological history. One the other hand is the recent view, proposed by S. Joseph Wright and Helene Muller-Landau, that net losses of tropical forest cover are likely to be far more modest than previously suggested, at least over the coming century, so that the number of extinctions that might be caused by habitat loss should be re-evaluated downwards. This latter argument is largely based on analyses that suggest that (1) human population growth is slowing, especially in tropical rural areas; (2) large areas of secondary forest are becoming established naturally so that net deforestation is slowing; and (3) many tropical species will be able to persist in secondary and logged forests (Wright & Muller-Landau 2006a, 2006b). As might be expected, an emerging debate of this nature, with its critical and far-ranging implications, has precipitated vigorous rejoinders and counter-arguments (Brook et al. 2006; Gardner et al. 2007; Sloan 2007; Laurance 2007). This dispute revolves around two general questions. First, what factors actually drive tropical deforestation and prevent natural secondary sucession from re-establishing forest cover? Second, what are the biological consequences of the ongoing loss of primary, old-growth forests and of increases in secondary and logged forests? Both questions have many layers of complexity. For example, the proximate and ultimate factors that drive net changes in tropical forest cover involve disparate social, economic, human-demographic, and policy considerations that originate within and differ among tropical countries as well as extrinsic factors related to trade and global economic development. We propose to convene a symposium at the ATBC-Morelia meeting that focuses on this debate. The six speakers would be evenly divided between those who generally support the Wright and Muller-Landau perspective, versus those who oppose it. The goal would be to provide the audience with an overview of the emerging issues and research questions at the center of this important and timely debate.

10:00 Land use change, climate change and the extinction of tropical forest species

S. Joseph Wright[1] and **Helene Muller-Landau**[2]
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It is widely predicted that the conversion of tropical forests to agriculture and other human uses will lead to a mega-extinction event similar in severity to the mega-extinction events that define geological epochs. We believe this prediction is unlikely to be realized, and that conservation strategies should be adjusted to allocate more resources to combat other threats. Three factors combine to mitigate the extinction threat posed by land use change. First, though old-growth forest continues to be lost, secondary forests are increasing in area. Thus most recent land cover models, including those in the Millenium Ecosystem Assessment, predict that total tropical forest cover will not fall below 30% of its pre-industrial extent. Second, many tropical species do not require old-growth forests. We will use the birds of Panama to illustrate how tolerance to land cover change varies among species. Third, tropical biodiversity is greatest in the Americas where land use conversion is relatively limited. For example, of 155,000 described tropical plant species, 90,000 are restricted to the Americas. Climate change might already have overtaken land use change as the leading cause of documented extinctions on tropical continents. This includes large numbers of tropical montane amphibians that have been driven extinct by pathogens that have benefited from altered climates over the past 20 years. The potential for climate change to cause tropical species extinctions has important conservation implications. Each nation is responsible for governing land use within its sovereign territory, and thus, tropical nations bear responsibility for addressing extinction threats due to land use change. In contrast, it is largely wealthy non-tropical nations that have precipitated the climate crisis and should shoulder primary responsibility for mitigating the resulting threats to biodiversity. Future climate change conventions must mobilize resources to prevent tropical species extinctions.

Keywords: biodiversity, conservation, climate change, land use change, deforestation

10:20 And now a word from Chicken Little: reflections on the tropical extinction crisis

William Laurance
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Joseph Wright and Helene Muller-Landau (WML) have recently argued that the future loss of tropical biodiversity is likely to be considerably lower than is widely anticipated. I critique several assumptions of their analysis, and suggest that it is premature to adopt such an optimistic perspective. Among their most fundamental assumptions is that future forest cover in developing nations will be largely determined by local population density. I assert, however, that increasing globalization and industrialization in developing nations will progressively weaken this relationship over time. WML further assume that future pressures on forests will decline because of slowing population growth and increasing urbanization, but I suggest that land conversion for both biofuels and food will accelerate markedly, exacerbating pressures on forests. In addition, the WML analysis focuses mainly on large continental regions, whereas tropical extinctions are likely to be greatest in smaller biodiversity hotspots that have high species endemism and already-severe forest loss. Finally, the WML projections of species extinctions focus solely on forest conversion, but a range of other further threatsincluding climatic change, exotic species

and pathogens, and a range of environmental synergismsare also likely to have serious impacts on future tropical biodiversity.

Keywords: Environmental synergisms, extinction, forest conversion, human population growth

10:40 Is there a global extinction crisis for biodiversity?

Nigel Stork
School of Resource Management, University of Melbourne

Many leading biologists have stated that the current extinction phase is more extensive and rapid than anything seen before, including the five well recorded mass extinction events that occurred in the last 500 million years when up to 70% of marine organisms previously known from fossil records disappeared. In 1993 Smith and co-workers assessed the rate of increase in extinctions for various groups of organisms by looking at the rate of change of the Red Data Book status of species as over time they move from rare possibly right through to extinction. Their assessment was that 50% of groups such as birds, mammals and palms might be extinct in the next couple of hundred of years or sooner. However, the vast majority of biodiversity are neither mammals or plants but are insects and other invertebrates. In an earlier study Nick Mawdsley and I found that for the British fauna, birds and mammals were much more endangered or rare than insects and other invertebrates. In this paper evidence is presented that supports the view that most invertebrates are much less likely to become extinct than vertebrates. I also examine current evidence that suggests that climate change may be a more insidious threat to global insect diversity than habitat loss. Previously I have also posed the view that many insects who have a strong host-specificity with either plant or animal hosts may suffer the same 'co-extinction' fate as their hosts. I review how much such co-extinctions may contribute to current extinction rates. In conclusion, I propose that biologists concerned by current extinction rates will get greater political traction and change by focussing their arguments for macroorganisms rather than biodiversity as a whole.

11:20 Size matters: the functional extinction of large vertebrates in tropical forests

Richard Corlett
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Anthropogenic global extinctions of tropical Asian forest vertebrates are still rare, but local and regional extinctions are widespread, although widely underreported because of wishful thinking or official embarrassment. Even where a species is still locally extant it may persist at such a low density as to be functionally extinct. To a first approximation, the vulnerability of tropical forest vertebrates to hunting and other human impacts increases with body size. The ecological roles of vertebrates are also strongly influenced by body size, and the largest species of carnivores, frugivores, browsers, and grazers have unique ecological roles that cannot be substituted by smaller species. These roles are now highly threatened, particularly in tropical Asia. Most tropical Asian forests have

lost most or all of their megafauna (> 45 kg) and many other large vertebrates (> 5 kg) now occupy only fractions of their former ranges. Hunting is the major threat to large forest vertebrates, so species-area relationships are likely to be a poor predictor of extinctions. Correlations between hunting, logging and fragmentation in tropical Asia make it difficult to assess their impacts separately, but current evidence suggests that many large vertebrates could persist in mosaics of secondary and logged forest if protected from hunting.

Keywords: hunting; extinction; Asia; forests

11:40 The potential of rural-urban migration and agriculture modernization to promote neotropical biodiversity conservation

H. Ricardo Grau[1], T. Mitchell Aide[2] & N. Ignacio Gasparri[1]
[1]CONICET-Universidad Nacional de Tucumán, Argentina
[2]Dept. of Biology, University of Puerto Rico.

The growing human population and the increase in per capita food consumption are increasing food demand. To balance increasing agriculture production and nature conservation, we must assess the efficiency of land-use strategies. In the Neotropics rural-urban migration is contributing to land-use efficiency by favoring the abandonment of marginal areas for agriculture, and promoting the consumption of agricultural products from modern systems of higher productivity. This process is favoring the conservation and recovery of tropical montane and dry ecosystems in different regions of the Caribbean, Central and South America. In contrast, the growing global demand for food has increased deforestation particularly in lowland ecosystems that are more appropriate for modern agriculture. For example, soybean production, mainly exported to China and Europe, has become the major driver of deforestation in dry forest/savanna ecosystems of South America. We compared land cover/use patterns and human population trends since the early 1970s in two regions with contrasting development pathways in the Chaco dry forests of northern Argentina. The area (c. 13 million hectares) includes one of the largest continuous patches of tropical dry forests and has experienced rapid land use change. In regions where land use has been driven by government-sponsored colonization programs, the expansion of extensive grazing has led to a growing rural population, low food production, and widespread environmental degradation. In contrast, in regions dominated by market-driven soybean expansion, the rural population has decreased, food production is between 300 and 800% greater, and low-density extensive cattle production has declined over extensive forested areas, resulting in a land-use strategy that better balances food production and biodiversity conservation. This study provides examples of how socioeconomic modernization can influence land-use change and have positive effects for biodiversity conservation.

Keywords: biodiversity, Chaco, land use change, modern agriculture, rural-urban migration.

12:00

Will urbanization cause deforested areas to be abandoned in Brazilian Amazonia? An examination of the Wright/Muller-Landau assumptions for the future of the world's largest tropical forest.

Philip M. Fearnside
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Rural-Urban migration has been hypothesized by Wright and Muller-Landau as a process that could reduce tropical forest loss worldwide and allow secondary forest to occupy abandoned clearings. However, the usefulness of this global generalization is highly dependent on its being correct for Brazilian Amazonia, which has the worlds largest remaining area of tropical forest. Among the features of the deforestation process that make urbanization an unlikely mechanism for land abandonment in Brazil is the fact that most deforestation is done by ranchers rather than by shifting cultivators. A family of shifting cultivators is only capable of farming a limited area and cannot greatly expand the area it cultivates if additional land becomes available. Ranchers, by contrast, can occupy huge areas and expand their holdings when the opportunity arises. Were part of the population to leave for the cities their land would usually be bought by neighboring ranchers who would maintain and expand the deforested landscape.

Keywords: Deforestation, Population, Migration, Secondary Forest, Rainforest

#14 Part I Tropical Oaks: Diversity, Ecology and Conservation

WENDESDAY JULY 18
Room 3: Cervantes Saavedra (Second Floor)
Building:Colegio Primitivo de San Nicolás de Hidalgo

Organized by:

- Jeannine Cavender-Bares, Department of Ecology, Evolution and Behavior, University of Minnesota
- Antonio González-Rodríguez, Centro de Investigaciones en Ecosistemas, Universidad Nacional Autónoma de México

Oaks (*Quercus*) are one of the most ecologically and economically important tree genera in the northern hemisphere as well as one of the most diverse and broadly distributed. The center of diversity is in tropical regions of Mexico and Central America (over 200 species), where they represent a major component of both tropical montane and tropical dry forests. Despite their ecological, evolutionary and economic importance, tropical oaks have been greatly understudied relative to their temperate counterparts. In this symposium, we focus attention on the high diversity of tropical oaks at both intrageneric and intraspecific levels, ecophysiological differentiation across environmental gradients, regeneration ecology, interaction with predators and seed dispersal agents, and conservation. In focusing on tropical oaks, we bring together a broad spectrum of perspectives to increase understanding of the biology of the genus in regions where it has received comparatively less attention

10:00 Phylogenetic analysis of series Lanceolatae of genus Quercus

Susana Valencia Avalos
Herbario de la Facultad de Ciencias, UNAM

Quercus affinis and *Q. laurina* are two species in genus *Quercus* with a wide geographic distribution in Mexico, ample morphological variation, problems of taxonomic assignment, and hybridization in areas of sympatry. These species were included by Trelease in the Series Lanceolatae (section Lobatae) and later by Camus in the subsection Lanceolate. However, the 133 series of American oaks proposed by Trelease appear to be artificial groups with dubious delimitation. The present analysis was preformed with the goal of recognizing the monophyletic group that, according to Trelease, includes *Q. affinis* and *Q. laurina* (series Lanceolatae), and to understand the relationship between these two and other related red oak species. A maximum parsimony phylogenetic analysis was performed including 30 species from the 18 series that according to Trelease comprise the red oak group (section Lobatae). Character states were analyzed for 42 morphological characters using the programs WinClada and Nona for PC. Five analyses, each with 1000 replicates, were preformed, using *Q. crassifolia* to root the trees. Support for the trees was evaluated using both bootstrap and jackknife. Twenty equally most parsimonious trees 237 steps in length were obtained, with a consistency index (CI) of 0.28 and a retention index (RI) of 0.48. The topology of the resulting trees does not

provide support for the inclusion of *Q. affinis* and *Q. laurina* in a monophyletic group denominated Lanceolatae, and the same conclusion applies for most of Trelease's series included in this analysis.

10:20 Introgression among oaks: prevalence and underlying mechanisms

Remy J. Petit
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Along with dandelions and blackberries, oaks make up some of the most famous 'botanical horror stories', because of the alleged difficulty to identify oak species. This is typically attributed to frequent hybridization and introgression. Such interspecific exchanges are a source of difficulties but also of opportunities for ecologists and conservationists. Here I describe the prevalence of introgression in oaks, including those from (sub)tropical, species-rich regions. I show that this question cannot be properly addressed without consideration to the related aspect of species delimitation. I discuss the mechanisms underlying introgression and conclude that a good understanding of introgression implies to view species ranges as dynamic entities. If not considered, introgression has the potential to be extremely misleading; however, if properly understood, introgression will provide great opportunities and research material for the ecologist and will help link intra and interspecific studies on biodiversity.

Keywords: chloroplast DNA, Quercus, introgression, species delimitation, phylogeography

10:40 Introgressive hybridization and range advance in California red oaks

Richard S. Dodd and **Zara Afzal-Rafii**
Department of Environmental Science Policy and Management, University of California, Berkeley

The red oaks (*Quercus* sect. *Lobatae*) of California include four interfertile species that occupy distinct habitats. The two most common evergreen oaks are coast live oak (*Quercus agrifolia*) that is adapted to warm, relatively moist conditions in the Coastal Mountain Ranges, and interior live oak (*Q. wislizeni*) that is adapted to a drier habitat with more extremes of temperature (hot summers, cold winters) typical of the inner Coastal Mountain Ranges and the foothills of the Sierra Nevada. In the northern and interior limits of the range of coast live oak, morphological hybrids with interior live oak are common, where topography and exposure bring the two species into sympatry. South and west of these range limits, coast live oak commonly displays morphological characteristics considered typical for the species. Throughout this geographic region, including the northern and eastern range limits, we found that chloroplast haplotypes for both species were exclusively of one type that could be attributed to interior live oak. Our progeny arrays confirm maternal inheritance of chloroplast DNA in these species, indicating chloroplast capture by morphotypes of coast live oak. Nuclear microsatellites indicated population expansions in coast live oak. We propose that coast live oak expanded its

range over recent history, by a wave of hybridization with coast live oak the pollen donor. Selection differentials over the landscape favoured coast live oak nuclear genes as coastal climate became moister. Results are discussed in the light of expected future climate change.

11:20 Patterns of genetic variation sharing among Mexican red oak species

Antonio Gonzalez-Rodriguez [1], Selene Ramos-Ortiz [1], Henri Caron [2], Antoine Kremer [2] and **Ken Oyama [1]**

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Related species in genus *Quercus*, even if clearly morphologically and ecologically different, have repeatedly been shown to exhibit low levels of interspecific genetic differentiation for neutral markers of both nuclear and cytoplasmic origin. These results have been most often explained as a result of a high rate of introgressive hybridization among oak species. However, it can be difficult to distinguish the effects of interspecific gene flow from the alternative scenario of shared ancestral variation as causes for the limited divergence observed. Here, we use seven nuclear and two chloroplast microsatellite loci to investigate the extent of genetic variation sharing among seven Mexican red oak species (*Q. affinis, Q. crassifolia, Q. crassipes, Q. laurina, Q. ocoteifolia, Q. mexicana* and *Q. rubramenta*). These species encompass different degrees of relatedness, overlap in geographic distribution and presumed levels of hybridization. By contrasting the genetic results with morphological, phylogenetic and geographic information, we attempt to disentangle the causes for the patterns of genetic variation sharing in these species.

Keywords: Quercus, genetic variation, microsatellites, hybridization, ancestral polymorphisms

11:40 Understanding genetic patterns in disjunct species of Mexican Quercus: a case study of Section Lobatae Subsection Racemiflorae

Ross A. McCauley, Aurea C. Cortés-Palomec, and **Ken Oyama**
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Quercus L. Section *Lobatae* Loudon Subsection Racemiflore A. Camus is a small group of four species of Red Oak (*Q. conzattii* Trel., *Q. radiata* Trel., *Q. tarahumara* Spellenb., J.R. Bacon, & Breedlove, and Q. urbanii Trel.) extending from Chihuahua to Oaxaca and occurring between 1000 and 2600 m in elevation. The four species form a natural group united by their production of fruits on long racemose inflorescences. While the group has a relatively wide distribution it is largely restricted to small habitat "islands" due to an affinity for exposed mineralized soils. Coupled with a patchy occurrence the group also

exhibits a clear bicentric distribution, a rare pattern exhibited in only a few species of Mexican oaks. Two species of the Racemiflorae span this disjunction and show only minor morphological differences across their range. *Quercus urbanii* exhibits a disjunction in its range of approximately 700 km from mountain slopes near the Balsas Depression to the western Sierra Madre in Sinaloa and adjacent Durango. *Quercus conzattii* extends this pattern further with a disjunction of approximately 850 km from its southern area of distribution in the mountains of Oaxaca to the southern Sierra Madre Occidental in northern Jalisco, southern Durango, and western Zacatecas. Using a combination of chloroplast and nuclear microsatellite markers across 48 populations of the four species of Racemiflorae we have been able to identify unique species and regional haplotypes and to analyze patterns of genetic diversity among the disjunct regions and species. Inferences of phylogeographic pattern and identification of regions of high levels of historical gene flow are able to provide clues to the origin of the present day bicentric distributions.

Keywords: Quercus, Tropical Oaks, Phylogeography, Mexico

12:00 Ecophysiological and genetic differentiation of live oaks (Quercus section Virentes) across a latitudinal gradient from the tropics to the temperate zone

Jeannine Cavender-Bares [1], Annette Pahlich[1], Antonio Gonzalez-Rodriguez[2], Nicholas Deacon[1] and **Jessica Savage[1]**
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An unresolved question in ecology is whether widely distributed species are able to persist across a range of climates due to broad physiological tolerances or to local adaptation. The live oaks (*Quercus* section *Virentes* Nixon) form a species complex that occurs in lowland and coastal forests from the dry tropics of Costa Rica to temperate North Carolina. Two broadly distributed species, *Q. virginiana* and *Q. oleoides*, together span this entire range. Neutral genetic markers analyzed for both species throughout Central America and the southeastern U.S. revealed three distinct groups, including a unique Costa Rican population. Further genetic subdivisions were found within each group. In a greenhouse experiment, *Q. oleoides* seeds from two geographically isolated populations in Costa Rica and Belize as well as *Q. virginiana* seeds from northern Florida and North Carolina were grown under contrasting temperature and drought regimes. Species, and populations within them, showed clear differentiation by latitude in sensitivity to freezing. The northern-most population of *Q. virginiana* was able to prevent freezing damage after cold acclimation more than the southern population. Neither population of *Q. oleoides* was frost resistant. *Q. virginiana* populations, particularly from the northern range limit, also showed greater leaf shedding in response to cold temperatures and lower freezing induced xylem embolism. The Costa Rican population of *Q. oleoides* maintained higher hydraulic conductance in well-watered conditions, had higher stomatal pore area and higher xylem porosity compared to the other populations. These results indicate significant genetic differentiation between populations and between species consistent with adaptive divergence. Multiple lines of evidence, including nuclear microsatellites, chloroplast sequences and functional traits in common

gardens reveal that the live oaks of Costa Rica are genetically distinct from the rest of the Virentes. These results have important conservation implications for the highly fragmented tropical live oak forests of Costa Rica.

Keywords: Quercus, live oaks, genetic differentiation, latitudinal gradient, ecophysiology

15 Diversity and Evolution of Pollination and Mating Systems of Tropical Plants

WEDNESDAY JULY 18
Room 4: Sala Rectores (Second Floor)
Building: Centro Cultural Universitario

Organized by:
- W. John Kress, Department of Botany, Smithsonian Institution
- Qing-Jun Li, Xishuangbanna Tropical Botanical, Chinese Academy of Sciences

The diversification of many groups of flowering plants has been attributed to adaptive radiation of pollination modes and mating patterns. Many unique and intricate pathways of floral evolution are evident within particular tropical families ands in recent years, many novel pollination mechanisms have been discovered in tropical ecosystems, providing the potential for comparative and phylogenetic studies of the evolution of reproductive traits. The main goal of this symposium is to describe and compare the evolution and ecology of pollination and mating systems of tropical plants, especially with regards to adaptive radiations, generalized vs. specialized systems, and evidence for coevolution in mutualistic relationships. Examples from Asian, African and American tropical habitats will be presented.

10:00 Pollinator generalization and specialization across a geographic mosaic: hummingbirds and heliconias of the eastern Caribbean

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Thompsons (2005) Geographic Mosaic Theory of Coevolution predicts that the degree of specialization and interdependence between mutualistic species will vary in space and time. Here we use a geographic approach to examine how a hummingbird Heliconia relationship changes across islands in the eastern Caribbean and discuss the associated changes in floral and pollinator traits. On the island of Dominica, flowers of H. bihai are pollinated exclusively by female purple-throated caribs (Eulampis jugularis), and have long curved flowers matching the females long, curved bills. On Grenada, Trinidad, and Tobago, flowers of H. bihai are 30% shorter, yet are pollinated by as many as five different hummingbird species with bills ranging from 18 to 40 mm in length. Feeding experiments with natural and artificial flowers demonstrate that the long, curved flowers of H. bihai on Dominica are inaccessible to short-billed hummingbirds, whereas the short, curved flowers of H. bihai on Grenada, Trinidad and Tobago are easily accessed by short- and long-billed hummingbirds, as well as by hummingbirds with highly curved bills. We suggest that the extreme pollinator specialization on Dominica is a consequence of depauperate island flora and faunas resulting from increased geographic distance from mainland source pools, which facilitates both plant and pollinator character displacement.

Keywords: Pollination; Coevolution, Heliconias, Hummingbirds, Specialization

10:20 Maintenance of flexistyly in *Alpinia* spp. (Zingiberaceae): the role of morphology, ecology and genetics

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Flexistyly is a novel sexual dimorphism by reciprocal style movements and pollen dehiscence, which found in genera *Alpinia* and *Amomum* of ginger family. Populations of flexistylous species comprise two floral morphs that differ in the direction of movement that styles undergo and time of pollen sheds during flowering, one releases its pollen in the morning, and holds its stigma out of the way of pollinators; the other morph holds back its pollen, but its stigma is downward-curved and receptive to pollen-laden insect. Around midday, these two floral morphs swap sexual roles through reciprocal style movement. Here, we propose that the maintenance of flexistyly in the population may depend on the genetic control, and the exact timing of stigma and anther maturity, and the pollination environments. We tested these hypotheses by hand pollinating between and within morphs, morph ratio survey of natural populations, style movement behavior related to the ecological environment, and mating system detections of four species. Our results show that one Mendelian locus with two alleles control the movement of the style and the time of pollen sheds, cataflexistylous morph is recessive homozygote (ss), anaflexistylous morph are dominant heterozygote (Ss). In the natural population, no chance to form homozygote anaflexistylous individuals, in this case, the morph ratio of 1:1 could be maintained. The study of four species' mating systems indicate that flexistyly plays an important role to encourage outcrossing, but at the same time, interference between sexual functions also be prevented.

Key words: *Alpinia*; flexistyly, experimental pollination, heterodichogamy, mating system, Mendelian inheritance, morph ratio, sexual dimorphism, Zingiberaceae

10:40 Adaptive trade-off in corolla shape mediates specialization for flowers pollinated by bats and hummingbirds

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Evolution towards increased specificity in pollination systems is thought to have played a central role in the diversification of angiosperms. Theory predicts that the presence of trade-offs in adapting to different pollinator types will favor specialization, yet few studies have attempted to characterize such interactions in nature. I conducted flight cage experiments with bats, hummingbirds, and artificial flowers to examine effects of corolla width on pollination. I videotaped visits to analyze pollinator behavior, and counted pollen grains transferred to stigmas. Results demonstrate that flower-pollinator fit is critical to

effective pollination; wide corollas guided bat snouts better and narrow corollas guided hummingbird bills better. Poor fit resulted in variable entry angles and decreased pollen transfer. A model using these results predicts that wide corollas will be selected for when bats make more than 44% of visits and narrow corollas when they make less. Intermediate corollas are never favored (i.e. generalization is always suboptimal). This is the first study to clearly document a pollinator-mediated fitness trade-off in floral morphology.

Keywords: Burmeistera, disruptive selection, fitness trade-off, flower-pollinator fit

11:20 Island invaders: the role of introduced mutualists in pollination in Mauritius

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Little is known about the effects of introduced species, or the removal of invasive plant species for habitat restoration, on native mutualistic plan-pollinator interactions. We used fully quantified flower visitation webs to investigate plant-pollinator communities of a restored and an unrestored site in Mauritius. Interactions between all flowering plant species and their pollinator species were recorded for both sites for an eight month period. The restored site showed higher plant and pollinator species richness and abundance than the unrestored site. Plant species in the restored site produced larger and heavier fruits, which contained more seeds per fruit than those in the unrestored site. Visitation webs in both sites were dominated by a few super-abundant, disproportionately well-connected plant and pollinator species, and many rare and specialised species. Most key animal species were introduced to Mauritius. Introduced plant species produced a high fruit set, despite being visited by relatively few pollinators. Our findings indicate that the effect of introduced species on plant-pollinator interactions may differ according to whether they are plants or pollinators. The low visitation rate to introduced plant species suggested a low level of indirect competition for pollinators with native plant species. However, the infiltration of the local pollinator community by introduced flower visitors suggested strong competition between native and introduced pollinators for floral resources, which may have resulted in the displacement of native pollinators and consequently the disruption of co-evolved plant-pollinator interactions.

Keywords: pollination, mutualistic networks, Indian Ocean, habitat restoration

11:40 Potential ecological and evolutionary responses of a plant-pollinator system due to human induced climate change

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Fossil records are the ancient proofs of how climate changes affect the species distribution as well as plant-animal interactions. Since the industrial revolution, global temperatures and atmospheric carbon dioxide have been rising steadily. Here, we examined the potential effects of human induced climate change on plant-pollinator interaction of Abutilon rufinerve (Malvaceae), a Brazilian montane forest species. Abutilon rufinerve is a self-incompatible species in which flowers opened at dawn and last 2 days (71% of the flowers), producing nectar by day and night at a rate equivalent to 21.9 Joules per hour. Flowers were visited by hummingbirds (0.98 visits.flower-1.hour-1) and bats (0.42 visits.flower-1.hour-1). Selective floral visitor exclusion
experiments resulted in similar fruit-set for nocturnal and diurnal pollinators. Bats, however, were more effective pollinators, accounting for ca. 70% of the seed-set, because fruits originated from bat pollination had more seeds. Bats leaving from shelter were correlated with air temperature, with almost no activity at nights with temperatures lower than 8o C at 6 pm, and frequency of visits are lower during colder nights. Nectar was found in open flowers in the end of night, but not at the end of the day, indicating that hummingbirds may be benefitted by lower activity of bats during colder nights. Considering Abutilon rufinerve interplant variation in floral color and size and differential response of nocturnal and diurnal pollinators to temperature variation, there is potential to increase differential selective pressure made by bats and hummingbirds with the recent climatic changes. We considered several alternative outcomes relating effects of climatic changes on nectar production and distribution of plants, bats and hummingbirds to the ecological and evolutionary fate for this plant-pollinator system. FAPESP03/07088-9.

Keywords: bats, global warming, hummingbirds, plant fitness, pollination

12:00 Between a rock and a hard place: figs, pollinators, and parasites in the Sonoran Desert

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In recent years, study of mutualism has provided great insight into the processes of coevolution and the dynamics of species interactions. Increasingly recognized is that geographic variation in both the biotic and abiotic environment external to a mutualism must be considered to fully understand the fitness costs and benefits of mutualisms, how and why these benefits vary in space, and how mutualisms are stabilized over ecological and evolutionary time. Our research focuses on a fig-fig wasp system composed of the Sonoran Desert Rock Fig, Ficus petiolaris, its obligate pollinating wasp, and associated non-pollinating wasp parasites. This system represents the environmental limits of fig-fig wasp mutualisms in North America. In a stressful desert setting, F. petiolaris populations are often small, spatially isolated, and consequently at high risk of local pollinator extinction and mutualism breakdown. Mutualism in these populations may be stabilized by reproductive adjustments in the fig (intra- crown asynchrony, extended duration of

receptivity to pollinators). These adjustments by the plant, however, may also prove beneficial to non-pollinating parasites, which can impact fig reproduction and pollinator persistence. Our work investigates the effects of geographic variation in population size on the stability of the fig-fig wasp mutualism, examining to what extent figs adjust their reproductive schedules to mitigate risk of pollinator loss, and assessing the effects of parasites on the maintenance of demographically stable pollinator populations. Our findings provide novel insights into how biotic and abiotic factors can modulate interactions among mutualists, influence local mutualism stability, and determine species geographic and environmental ranges.

Keywords: Mutualism, fig, pollinator, parasite

16 Part I Ecology of coffee agro-ecosystems

WEDNESDAY JULY 18
Room 5: Aula Mater (First Floor)
Building:Colegio Primitivo de San Nicolás de Hidalgo

Organized by:

- Peter Hietz, Institute of Botany, University of Natural Resources and Applied Life Sciences, Vienna, Austria

Coffee is the main cash-crop of many tropical countries with globally more than 10 million hectares dedicated to its cultivation. The strong fluctuations of international coffee prices have strong repercussions on human livelihood and land use, and, given the extensive loss of forests, in many areas coffee with shade trees has become the dominant arboreal vegetation. The way coffee is cultivated (ranging from extensive cultivation in almost natural forests to intensive plantations without shade trees) is strongly related to the economic, social and cultural environment and strongly affects the ecology. This symposium will compare the effect of different cultivation systems on ecosystem services, biodiversity and production, including the human dimension in these important ecosystems.

10:00 A multi-taxonomic and multi-scale evaluation of the role of shade coffee farms in conserving regional biodiversity in central Veracruz, Mexico

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Agroecosystems in general, and shade coffee farms in particular, are increasing important components in assuring the conservation of Mexican biodiversity and the socio-economic well-being of an important sector of the country. However, the current global crisis of technification, overproduction, and low prices may result in land-use changes that have dire consequences for conservation efforts in regions of tropical montane forests. The development of sustainable management practices to address this problem will require clearer understanding of the effects of different management strategies on biodiversity and key ecosystem services. Monitoring of 12 plant and animal taxa in 18 coffee farms and three forest control plots located in central Veracruz, Mexico, has documented over of 1,862 species to date. While taxonomic responses to increases in management intensity are not uniform, patterns are clearer in taxa sampled in more study sites and once generalist species are eliminated. Overall the shade coffee farms studied appear to conserve a significant and unique fraction of the biodiversity of cloud forest fragments remaining the region. Furthermore, variation both within and among coffee farms appears to play a role in explaining changes in biodiversity suggesting a that these agroecosystems should be explicitly included in regional conservation planning. More traditionally managed farms also exhibited rates of carbon sequestration, soil fertility, and water-holding capacity similar to that of the forest fragments studied. In addition these types of farms, particularly those located nearer to forest fragments

exhibited greater pollinator diversity, which in turn was positively correlated with seed set of coffee plants. The potential of these ecosystem services to generate additional sources of revenue for coffee growers in the region is discussed and future research directions are highlighted.

Keywords: coffee agroecosystems, tropical montane forest biodiversity, management intensity gradient, ecosystem services, landscape scale

10:20 Quantifying the forest in the trees: conservation agroecology lessons from birds and beetles in coffee

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Multitaxonomic perspectives have emerged as an important tool for assessing the biodiversity conservation value of coffee agroecosystems. I combine information from separate studies of birds and beetles in coffee farms from two different Mexican coffee producing regions, to address the general question: How much biodiversity conservation bang can you get for your buck in coffee agroecosystems? In a study based on 5 years of bird point counts and economic data from interviews with the owners/managers of coffee farms spanning an intensification gradient in central Veracruz, two coffee farms under the ³bajo monte² cultivation system were highest in forest bird species richness and abundance, and were also among the most profitable farms. The richness and abundance of forest-affiliated bird species on bajo monte farms were comparable to those of small patches of intact forest in the region, though depauperate in understory species. Bajo monte coffee was more profitable than the commercial polyculture farms that dominate the region, and comparable in profit to highly intensified coffee farms under normal coffee price scenarios. This suggests that converting farms to the bajo monte cultivation system could enhance biodiversity and increase farmers¹ profits simultaneously. A study of beetles aspirated from coffee foliage on four southern Chiapas coffee farms revealed a very species rich assemblage (293 morphospecies classified from 2662 specimens), with higher species accumulation curves and more between-farm compositional variation in two farms under high-shade cultivation than in two farms under low-shade cultivation. High-shade farms also had lower abundance of the Coffee Berry Borer (Hypothenemus hampei Ferr.) than did low-shade farms, consistent with the idea that increased diversity confers a degree of pest population control. Birds and beetles each paint a different picture biodiversity in coffee agroecosystems, but a common thread is the opportunity for simultaneous economic and biological gains through high shade management.

Keywords: birds, beetles, coffee, agroecology, biodiversity

10:40 Coffee landscape and production strategies in Central Veracruz, México

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This paper analyzes how particular land management regimes become dominant over time and space through the confluence of ecological, socio-economic, and cultural drivers. I do this by studying the coffee production strategies playing out in nine counties within Central Veracruz region, which embody a complex set of ecological, social, and political interactions that come into play within the coffee commodity agro-chain. By using direct households interviews, digital maps and GPS registration of farming strategies, I found six different production strategies: cash mosaic; coffee monocrop; coffee mosaic; coffee subsistence; livestock subsistence and subsistence strategies. In order to understand the development of these varied coffee farming, and their spatial distribution, I suggest that the current land use model and the production strategies performed by the growers conform what I call a *bricolage landscape*, which is the outcome of the relationships between social marginalization, landform heterogeneity and farming choices. I contend also that these relationships are driven by new ways of access to the means of production, locally based perceptions of environmental risk, and processes of small farmer empowerment. Differently than in former periods where landscape homogeneity and high-tech were encouraged by international market and regulation policies, the *bricolage landscape* expresses how marginalization and land heterogeneity factors are performing particular roles in specific coffee production regions. The complexity of different production strategies composes landscapes that express the cultural representation of environmental and economic risk of each social group within a rural commodity network as occurred in the nine counties studied. I discuss the use of the landscape concept as an integrative part of my approach. This view is then applied explicitly to the examination of coffee production in nine counties within this region, focusing on an in-depth analysis of coffee production strategies. Finally, a qualitative analysis on its farming strategies is integrated to a historical review of coffee landscape evolution in the state of Veracruz.

Keywords: bricolage landscape, coffee strategies, landform

11:20 Examining epiphyte and bird connections in coffee plantations: experimental studies

Andrea Cruz Angón[1], Russell Greenberg[2] and **T. Scott Sillet[2]**
[1]Comisión Nacional para el Conocimiento y Uso de la Biodiversidad (CONABIO)
[2]Smithsonian Migratory Bird Center

Epiphytes, a common element of some neotropical forests and agroforest canopies, have often been thought to play a role in supporting higher bird diversity in tropical versus temperate forests. We tested the relative importance of epiphytes supporting birds' diversity and abundance, and their role as a key habitat feature for habitat selection in birds. We established two matching pairs of epiphyte removal and control plots in shaded Mexican coffee agroforest. We conducted bird censuses (2000 – 2001) to compare bird abundance and diversity among experimental plots. We used multistate, capture – recapture models to investigate how the experimental removal of epiphytes affected monthly survival and habitat selection based on the presence of epiphytes of individually colour banded Golden Crowned Warblers (GCWA) and Common Bush Tanagers

(CBTA). Overall 91 species of birds were recorded, 45 residents and 47 migrants. Bird abundance was significantly reduced in epiphyte-removed plots. In this plots bird diversity significantly decreased during the non-breeding season. We found that 45% of resident species and 36 % of migrants were more abundant in plots with epiphytes. Only 25% of migrants; and 12 % of the residents were more abundant in epiphyte-removed plots. Hummingbirds and tanagers were primarily restricted to plots with epiphytes.
Capture – recapture models showed that survival rates were not dependent on the presence of epiphytes. However, CBTA were at least 5 times more likely to emigrate from plots where epiphytes were removed compared to control plots. Habitat-specific movement patterns were not detected in the GCWA. Unlike the warbler, CBTA depend upon epiphytes for nest sites and for foraging. These dispersal patterns imply that active habitat selection based on the presence or absence of epiphytes occurs in the CBTA on our study area. Our results emphasize the importance of epiphytes as a bird resource in Neotropical coffee agroecosystems.

Keywords: birds, biodiversity, community structure, shade coffee management, vascular epiphytes

11:40 Pest control in a spatially explicit coffee agroecosystem

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The coffee agroforestry system provides an ideal platform for the study of spatial ecology. The uniform pattern of coffee plants and shade trees allows for the study of pattern generation through intrinsic biological forces rather than extrinsic habitat patchiness. In a 45-hectare plot in a coffee plantation we have been studying the emerging spatial pattern of the ant Azteca instabilis and the effects that the clumped distribution of this ant has on three very different pest species in coffee. We propose that the spatial pattern of Azteca emerges from a Turing mechanism associated with the dispersal of the ant at the local scale and a density-dependent control exerted at a larger scale by a phorid fly parasitoid. We also propose that through complex ecological interactions this spatial pattern is responsible for the control of three coffee pests: a mutualistic scale that is typically a secondary pest in coffee, the coffee berry borer, which is considered the main insect coffee pest in the word, and the coffee rust, a fungal disease considered the main coffee disease worldwide.

Keywords: ants, mutualism, emergent pattern, biological control

12:00 Synergistic Interactions between vertebrate insectivores: bats and birds control arthropods in a coffee agroforest

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The role of insectivorous birds in regulating arthropod populations and reducing consequent herbivore damage has received attention in both natural and managed ecosystems. While it is widely believed that bats have similar impacts on herbivore populations, little quantitative data exist demonstrating their effects on arthropods. We therefore studied the impacts of avian and chiropteran insectivory on the standing arthropod crops in Finca Irlanda, an organic coffee plantation in southwestern Mexico supporting a diverse population of foliage-gleaning insectivorous birds and bats. In January 2007, we erected 22 exclosure blocks, each comprising 4 treatments: birds excluded, bats excluded, birds+bats excluded, and control. Bird exclosures were erected only during the day, and bat exclosures during the night. Exclosures were made of agricultural netting (mesh size 20x20mm) erected around frames enclosing individual coffee plants. Arthropods on experimental plants were visually censused biweekly; after 50 days arthropods were collected for identification, and herbivore damage to leaves assessed. An increase in arthropod numbers was observed after 4 weeks of exclosure treatments; these increases were maintained throughout the rest of the experiment. A repeated-measures ANOVA using initial arthropod density as a covariate indicates significant increases in total non-colonial arthropods, large (≥4 mm) arthropods, orthopterans, and non-sternorrhynchan homopterans. Combined bird+bat exclosures had the greatest effect, followed by the bird-only and then bat-only treatments, which produced similar impacts. Our preliminary results suggest a synergistic interaction between bird and bat predation, demonstrating how maintenance of diverse predator communities can result in increased impacts on lower trophic levels. We discuss our results in the contexts of ecosystem services in managed areas and top-down effects in structuring tropical forest communities.

Keywords: top-down control, predation, agroecosystems, ecosystem services, mammals

12 Part II: Approaches To The Study Of Ecosystem Services Provided By Tropical Systems

WEDNESDAY, JULY 18
Room 1: Teatro José Ruben Romero
Bulding: Teatro José Ruben Romero (Auditorium)

Organized by:
- Patricia Balvanera, Centro de Investigaciones en Ecosistemas, Universidad Nacional Autónoma de México
- Helena Cotler, Instituto Nacional de Ecología, Mexico

14:00 Magdalena river watershed's ecosystem services, at Mexico City

Lucía Almeida-Leñero, Mariana Nava Ramos, Julieta Jujnovsky and **Maria de Jesús Ordoñez**
Facultad de Ciencias, Universidad Nacional Autónoma de México

Magdalena river watershed (MRW) covers 3000 ha that belong to the conservation soil of Mexico City. It features different forests: *Pinus hartwegii*, *Abies religiosa*, and mixed forest of *Quercus* and is a source of several ecosystem services like provision, regulation and cultural ones. Due to the importance of the area it is essential to work with an approach of ecosystems management. Three ecosystem services were evaluated using several criteria like quantity of generated water, carbon storage by the vegetation biomass and the cultural inheritance. The water provision was estimated by water balance using Thornthwaite method, the carbon storage was calculated based on tree structural parameters like height, normalized diameter and basal area. The cultural inheritance was evaluated through the analysis of literature and interviews to inhabitants of the zone. The MRW generates annually 20 million m^3 of water (0.63 m3/s), *Abies religiosa* forest is the one that generates more water, this is consumed in two forms, (1) directly from the river by merchants and (2) for the urban zone that make potable only a third part of the total production. The carbon storage by the *Pinus hartwegii* forest is about 44 564 tC and in *Abies religiosa* is 83 603 tC. This service is consumed out of the watershed since it contributes to improve the air quality of Mexico City. The cultural inheritance originates since the prehispanic period and has being changed through the time, at present there are only few persons that work in the forest and in its majority are directed to touristic issues. This study is fundamental in order to get an accurate and updated diagnosis necessary to take decisions related to the maintenance, ecosystems services payment and the establishment of the management proposals, indispensable for the conservation and restoration of the MRW.

Keywords: Ecosistem Services, Ecosystem Management, Temperate Forest, Watershed

14:20

Flagship spaces to ensure long term environmental services provision: the study case of copalita basin in Mexico

Alejandro Velázquez[1], Alejandra Larrazábal[1], Ángel Priego[1], Gerardo Bocco[1] and **Helena Cotler[2]**
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[2]Centro de Investigaciones en Ecosistemas, Universidad Nacional Autónoma de México
[3]Instituto Nacional de Ecología

The close relationship between humans and nature has been understood by many ecologist and environmental scientist. There were several attempts to address how social organization needs to respond to biodiversity features and functions in order to achieve its conservation and sustainable use. Under this context the term ecosystem services arise as a reference to the many conditions and processes associated with natural ecosystems that confer some benefit to humanity, thus and considering the current situation (forest degradation and ecosystem loss constitute great threats to life on Earth), it is necessary to focus on three relevant aspects to biodiversity conservation in order to pinpoint those information needs most critical to strategy development,(1) the current distribution and integrity of remaining natural habitats and processes, (2) assessments of current and projected threats to existing natural habitats and (3) the degree of relationship between this threats and the social conservation-oriented drivers. This works is the first step to identifying critical areas and social drivers responsible of providing stability to maintain environmental services under the framework of long term perspective and participatory planning. For this two main sets of data have been produces, (1) a group of attributes directly related with the functional delineation of the watershed and therefore with bio-physics characteristics, and (2) the group of indicators that attempt to draw the actual socio-economic environment of the study area. Multicriteria evaluation was the method chosen to combine all the existing data and to generate different alternative scenarios. The target was to define a reference baseline to prioritize areas which will receive support from development programs to conserve environmental services. The process of modelling rely on the assumption that areas with better socio-economic organization are more likely to be successful in terms of their resources administration regard expected establishment of new development programs.

keywords: Environmental services, stakeholders, Multicriteria analisys, escenario development

14:40 Economic valuation of ecosystem Services for decision making: scope and challenges

Enrique Sanjurjo, José Carlos Fernández and **Iván Islas**
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Ecosystems provide a wide range of services that are useful for life maintenance and hence for human welfare. There are various reasons why markets have failed to assign a price on many of these services, but not having a price does not imply not having an

economic value. To analyze the value of ecosystems, including marketed and non-marketed goods and services, economists have developed the Total Economic Value Framework (TEV). Under this framework many valuation techniques have been developed to estimate the economic value for some of the non-marketed services such as: watershed protection, soil erosion and biodiversity conservation among others. But, why is valuing relevant? Is it useful for decision making? What are the areas of application and what are the new challenges associated to them? These questions have been addressed for more than a decade and are still open for discussion and analysis. In recent years, the National Institute of Ecology has received several requests related to the value of ecosystems and their functions. We have found several motivations behind such requests: defining fines or compensations for ecosystem damages, evaluating projects, justifying budget, or just because doing valuation is "important". Understanding these motivations is the first step in defining what type of valuation is the most appropriate. Time, cost and precision are all relevant aspects to consider when choosing a particular valuation approach. We have learnt that valuation may be useful for policy making but we have also identified some severe limitations. In this paper we will show some examples in which economic valuation has been a useful tool for decision making as well as some cases in which the economic valuation of ecosystems was not the better way for attending the environmental problems for which the valuation was requested. We analyze the factors that contribute to a more limited utility of economic valuation studies. These limitations will be divided in two: those related with the concept of value itself, and those regarded with the limitations of the valuation techniques.

Keywords: Economic valuation, ecosystem services, decision making, policy making, environmental policy.

15:20 Ecological economics as an approach for ecosystem service studies

Sophie Avila-Foucalt
Centro Interdisciplinario de Investigación y Estudios sobre el Medio Ambiente y Desarrollo, Instituto Politécnico Nacional, México

Ecosystem services represent the link between ecosystem functions and human consumption. In order to understand ecosystem services, ecological and economic variables need to be related. In that sense, ecological economics is a useful approach since it allows building solutions based on the understanding of ecosystems and economic dynamics. Particularly, ecological economic modelling allows to integrated ecosystems processes with antropogenic variables and look to define the limits of growth without impairing ecosystem services in the long run. The paper presents an example of the importance of ecologcial economic models to link different ecosystem services, as well as, the impact in the long run of their maintenance for different economic activities. The paper will be focus on coastal ecosystems, and one of the examples, the Tonameca watershed located in Oaxaca Mexico, will be explored in more detail. The main environmental services studied are freshwater, agricultural and fisheries goods as well as scenic beauty.

Keywords: Ecosystem services, Ecologial economic model

15:40 Ecological services trading in rural communities: 10 years experience in Chiapas, México

Ben de Jong[1] and **Omar Masera**[2]
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[2]Centro de Investigaciones en Ecosistemas, Universidad Nacional Autónoma de México

The application of forest policies and land use to mitigate the effect of climate change could attend at the same time other needs and could offer effective mechanisms to combine climate change mitigation with the restoration of the biosphere. Greenhouse gas mitigation projects in the forestry sector are particularly attractive when they combine social, ecological and economic goals. The implementation of such projects at the scale of the land user or community in the rural sector of Mexico World imply a large number of land users involved, a great variety of small-scale land use systems distributed over large heterogeneous landscapes, each site with a specific land management history, individually adapted to the personal interests and previous experiences of the farmer and local ecological conditions. The Scolel Té Project, set up in Chiapas, Mexico, was designed in order to evaluate if it is feasible the create a generic planning and administration system that World be able to produce and commercialize carbon sequestration by small-.scale farmers and rural indigenous communities that would both be in line with international ecological integrity criteria and locally specific development options. To design and operate a Project with the above-mentioned characteristics, 4 key principles were defined which would be used to test the system: 1: transparency for all actors; 2- simplicity; 3-flexibility; 4- base don evidence. In the paper the system currently known as “Scolel Te” will be explained, what are the key positive and negative issues of the system and how the technical, social and administrative aspects have been improved alter 10 years of experience with the sale of carbon credits on the voluntary market by local communities and small scale farmers in Chiapas and Oaxaca.

16:00 Protecting an endangered dry-tropical forest palm by promoting the ecosystem services it provides

Laura López-Hoffman, Irene Aguilera-Taylor and **Alejandra Corzo**
Centro de Investigaciones en Ecosistemas, Universidad Nacional Autónoma de México

The endangered palm, *Sabal pumos,* of the lower Balsas basin in Michoacán, México provides important provisioning, supporting, regulating, and cultural ecosystem services to local people. The palm is found in agricultural matrix of cornfields and cattle pastures. Palm leaves are an important fiber source for thatch and for making sombreros and handicrafts. The palm tree hosts several species of micro-endemic orchids. According to local people, palm tree stands are important regulators of the local climate. During the dry season, the economic well-being of many local people depends entirely on income generated from leaf-harvesting. Furthermore, during this period, the palm’s fruits are a life-saving feed source for cattle. Despite the many ecosystem services the palm provides, demographic analyses of *Sabal pumos’* population dynamics predict a 50% decline in the harvestable resource in the next 15-25 years, accompanied by a concomitant decline in leaf-harvesting income. The demographic decline is due to a lack

of palm seedling and juvenile recruitment. Our observations, coupled with information from harvester's interviews, indicate that fire and soil tilling are the main factors. Here, we present a community-based management plan for the palm that seeks to protect the palm's long-term survival by promoting the ecosystem services it provides to local people.

Keywords: Ecosystem services, Sabal pumos, plant demography, Sustainability, community-based management

17 The Evolutionary Ecology of Multispecific Interactions in Changing Environments

WEDNESDAY JULY 18
Room 2: Conservatorio de las Rosas (Auditorium)
Building: Conservatorio de las Rosas

Organized by:
- John N. Thompson, University of Califorinia-Santa Cruz
- Rodolfo Dirzo, Department of Biological Sciences, Stanford University

The goal of the symposium will be to evaluate our current understanding of the evolutionary ecology of multispecific interactions across a range of ecosystems. The speakers will evaluate how ecological and evolutionary processes interact to shape patterns of specialization, defense, and mutualism within these networks of interacting species. We also hope that speakers will discuss how we might develop more explicit coevolutionary studies on multispecific interactions over the coming decade. In addition, we have asked the speakers to explore in their talks how changes in landscapes may be altering the evolutionary ecological and coevolutionary processes that shape networks of interacting species.

14:00 Anthropogenically driven shifts in the nature and strength of antagonistic plant-animal interactions

Dirzo Rodolfo[1], Mendoza Eduardo[2] , Ruiz Betsabé[2], Aguirre Armando[3], López Juan Carlos[1]
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Land use and cover change leading to deforestation and fragmentation is recognized as the most critical current threat to tropical biodiversity. Information about these relationships largely focuses on the loss of species or populations in deforested and fragmented forests, but information is considerably limited regarding the consequences of fragmentation on species interactions, particularly antagonistic interactions between plants and animals. Here we report findings on the consequences of fragmentation on seed predation and folivory at two spatial scales: large, by comparing two rain forest areas with contrasting degree of conservation, Los Tuxtlas (LT: heavily impacted), and Montes Azules (MA: conserved); and short, by comparing, within LT, forest fragments vs. relatively continuous forest. The comparison across the two sites shows that, in contrast to MA, mammalian herbivores, but not small rodents, are significantly decimated at LT, leading to the local extinction of mammalian folivory; insect herbivory was not affected. In addition, seed predation patterns were heavily disrupted at LT: there was a differential effect with small seeds being heavily attacked, while large seeds remain unattacked. This led to differential recruitment patterns with an over-

representation of large-seeded species. These observations were corroborated by experimental manipulations, and some phylogenetically controlled comparisons. Small fragments within LT, as compared to continuous forest, exhibited significant decreases in insect folivory, considering both the entire plant community, and those species shared in the fragments and continuous forest. We found that such changes in folivory are likely the result of changes in top-down and not bottom-up controls. These results are consistent with recent findings in other Neotropical forests and suggest that significant disruptions in the regimes of herbivory and seed predation due to anthropogenic impact are occurring. In the long-run, such disruptions of species interactions may lead to shifts in the selective regimes that antagonistic animals impose on plants.

keywords: Fragmentation, seed predation, herbivory, plant-animal interactions

14:20 Coevolution in multispecific ant-plant interactions

Rico-Gray Victor[1] and **Guimaraes, Jr. Paulo R.**[2]
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Coevolution is the reciprocal evolutionary change among interacting species, which have to exhibit specific evolutionary changes as an outcome of the interaction. The Acacia-Pseudomyrmex interaction has long been considered as coevolved but few other cases have been confirmed. This is not surprising, since most ant-plant associations are largely fortuitous, non-specialized, and facultative, such that specialization between particular ant and plant species is rare; only occasionally does selection favor obligate interactions. The geographic mosaic theory of coevolution should best describe a coevolutionary process between ants and plants, because it is based on the idea that structured populations of interacting species experience local differences in the intensity of selection they impose on each other, which can lead to a geographic patchwork for traits involved in the interaction. Results using network analysis are suggesting intriguing patterns on specialization and coevolutionary theory in ant-plant interactions. The structure of ant-plant networks exhibits nested patterns, indicating that this form of asymmetry in specialization is a common feature of mutualisms between free-living species. Furthermore, interaction intimacy markedly affects the structure of these networks. When interaction intimacy is high, ant-plant interactions are compartmentalized into small groups, each one with a few plant and ant species. Whereas, when interaction intimacy is low, ant-plant interactions exhibit nested patterns. These results support a promising approach for the development of multispecies coevolutionary theory, leading to the idea that specialization may coevolve in different but simple ways in antagonistic and mutualistic assemblages, and that simple features of mutualistic interactions are likely to have important consequences for the coevolutionary process and the patterns it generates in the organization of biodiversity.

Keywords: mutualistic networks

14:40 Host plants and herbivores: divergence and tradeoffs in defenses in *Inga*

Coley Phyllis[1], Kursar Thomas[1], Lokvam John[2] and **Pennington Toby[3]**
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Inga is a speciose, Neotropical genus of forest tree that has recently radiated. We suggest that herbivores have caused strong selection for a diversity of defense investments, including extrafloral nectaries, synchrony, leaf expansion and wide array of secondary metabolites. More closely related species are not more similar in their chemical defenses, suggesting that selection has favored divergence rather than a co-evolutionary scenario that leads to more biosynthetically derived compounds. We do see evidence for novel compounds arising through biosynthetic embellishments as well as by combining unrelated pathways. However, the most common mode of evolution of secondary metabolites in Inga was by regulatory changes such that a subset of a shared chemical repertoire is expressed, making novel combinations of defenses. This is not the result of a specialized one-to-one relationship with herbivores, as each Inga species is fed on by a different suite of herbivores. The chemical divergence among Inga species despite their similarity with respect to habitat preferences, leaf morphology and DNA suggests that herbivores may be responsible for the rapid and recent speciation.

Keywords: Herbivory, secondary metabolites, Inga, extrafloral nectaries

15:20 Tropical forests are both evolutionary 'cradles' and 'museums' of leaf beetle diversity

McKenna Duane and **Farrell Brian**
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The extraordinary species diversity of tropical forests is usually portrayed as a relatively recent and rapid development or as a consequence of the gradual accumulation or preservation of species over time. These explanations have led to alternative views of tropical forests as evolutionary cradles or museums of diversity, depending on the organisms under study. However, fossil and other evidence implies that the evolutionary histories of diversification among tropical lineages of organisms may be expected to exhibit features characteristic of both cradle and museum models. This possibility has not been explored in detail for any group of tropical insects. From an extensively sampled molecular phylogeny of herbivorous Neotropical leaf beetles in the genus Cephaloleia, we present evidence for (i) comparatively ancient Paleocene-Eocene adaptive radiation associated with global warming and Cenozoic maximum global temperatures, (ii) moderately ancient lineage-specific diversification coincident with the Oligocene adaptive radiation of Cephaloleia host plants in the genus Heliconia, and (iii) relatively recent Miocene-Pliocene diversification coincident with the collision of the Panama arc with South America and subsequent bridging of the Isthmus of Panama. These results demonstrate that for Cephaloleia and perhaps other groups of organisms, tropical forests are at the same time both evolutionary cradles and museums of diversity.

Keywords: leaf beetles, Cephaloleia, adaptive radiation, macroevolution

15:40 Context dependent pollinator limitation in variable environments

Horvitz Carol[1], Matlaga David[1] and **Ehrlen Johan[2]**
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To determine if pollinators limit fitness, one needs to look beyond the effects on current fruit set. There may be tradeoffs and the environmental context will determine if an increase in current fruit set improves fitness or not. In this paper we examine the use of population growth rate and stochastic growth rate as fitness measures for evaluating pollinator limitation. The environmental context includes the presence of beetle seed predators and of frequency and sequence of high germination years. Although the empirical example we explore is not tropical, the message is exportable to the tropics: context matters.

Keywords: pollinator limitation, seed predation, stochastic growth rate

16:00 Specialization within coevolving networks of species

Thompson John N
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One of the major current challenges in coevolutionary biology is to understand how networks of interacting species coevolve. We now have multiple hypotheses suggesting that mutualistic networks may differ from antagonistic networks, especially in patterns of specialization among species. Some recent empirical studies of tropical and temperate networks have provided some support for these hypotheses, and some recent mathematical models have suggested additional hypotheses on how coevolution may shape large networks as well as small networks. In this talk I will outline our current understanding of how coevolution may structure species networks, based on these current hypotheses and results.

Keywords: coevolution, interspecific interactions, specialization

#14 Part II Tropical Oaks: Diversity, Ecology and Conservation

WEDNESDAY JULY 18
Room 3: Cervantes Saavedra (Second Floor)
Building:Colegio Primitivo de San Nicolás de Hidalgo

Organized by:

- Jeannine Cavender-Bares, Department of Ecology, Evolution and Behavior, University of Minnesota
- Antonio González-Rodríguez, Centro de Investigaciones en Ecosistemas, Universidad Nacional Autónoma de México

14:00 South American oaks: where are we?

Juan F. Fernandez-M.
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Fagaceae in South America exist only in Colombia represnted by two species: the common oak, *Quercus humboldtii* Bonpl. and the black oak (or purple oak) *Colombobalanus* (=*Trigonobalanus*) *excelsa* (Hernandez et al.) Nixon & Crepet. The common oak has a relatively well known history as pollen records indicate the colonization from Central America about 500,000 yr bp. However, the origin of the latter species remains unknown. Here, I review salient aspects of their biology and provide a state of the art of various population genetics studies performed at the national and landscape scales, discussing the conservation implications for these species.

Keywords: Quercus; South America; genetic diversity

14:20 Factors influencing arthropod community structure on Quercus, and consequences for defense evolution

Robert J. Marquis
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Much early theory in plant-herbivore interactions was based on studies of *Quercus*, in particular *Q. robur*. Herbivore faunas of *Q. robur*, and apparently those of other temperate deciduous *Quercus* species, are extremely diverse (200+ species). Studies from temperate oak species demonstrate that the abundance and diversity of these species are influenced by physical and chemical traits, leafing phenology as it affects leaf quality, competition (through induction), bird and arthropod predation, mutualism (Homoptera-ant and gall-ant interactions), and ecosystem engineering. These factors in turn have consequences for growth and reproduction of individual trees. The role of each of these factors, with a focus on ecosystem engineering, will be discussed for the

Quercus alba system in Missouri, USA. Predictions will be presented as to the role of these factors for the arthropod faunas of tropical oaks. Comparative studies between tropical and temperate species promise to reveal how the relative importance of these factors changes with latitude for *Quercus* in particular and tree species in general.

Keywords: herbivores, plant secondary chemistry, ecosystem engineering, phenology, predation

14:40 Dispersal of oaks by scatter-hoarding vertebrates: Are tropical oaks dispersal limited?

Michael A. **Steele**
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Recent studies in temperate forests demonstrate how acorn characteristics influence the behavior of scatterhoarding animals and in turn the dispersal and establishment of oaks (*Quercus*). In deciduous forests of the U.S., for example, there is now strong evidence of contrasting dispersal syndromes for white oak species (WO; Section *Quercus*) vs. red oaks (RO; Section *Lobatae*) due to differences in germination schedules (i.e., nut perishability). Numerous rodent species selectively cache RO acorns over those of WO due to these differences in germination, rather than other acorn traits (i.e., size, handling time, tannin or lipid levels). Here we (1) review evidence for this differential dispersal of temperate oaks and (2) report on a series of parallel experiments in central Mexico that strongly suggest an alternative view of dispersal for subtropical and tropical oaks. In behavioral experiments, we presented Mexican gray squirrels (*Sciurus aureogaster*) with pairs of acorns from 10 native oak species and observed, contrary to previous studies, that squirrels selectively cached larger acorns (usually WOs) with greater handling times, regardless of the perishability (i.e., germination schedules). However, when rapidly germinating WO acorns were cached, the animals also excised (and killed) the embryos of acorns, thus demonstrating a secondary sensitivity to germination schedules. Such results suggest limited opportunity for dispersal of all oaks by this mammal. We also selectively provisioned small mammals with tagged acorns and followed their fates at several field sites in central Mexico. The majority of these acorns died as a result of insect or fungal damage and desiccation, while < 5% of the acorns were removed by small mammals. These results, coupled with pre-dispersal mortality as high as 90% due to Curculio infestation, suggest that subtropical and tropical oaks may be subjected to higher rates of both preand post-dispersal predation and more limited opportunity for dispersal.

Keywords: Seed dispersal, scatter-hoarding, Quercus, small mammals

15:20 Genetic consequences of contemporary seed dispersal in California valley oak, *Quercus lobata*

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[1] Department of Ecology and Evolutionary Biology and Institute of the Environment,

University of California, Los Angeles
[2] Department of Forest Systems and Resources, Forest Research Institute, CIFOR-INIA
3Department of Ecology, Evolution, and Natural Resources, Cook College, Rutger University, New Brunswick

Seed dispersal has a profound effect on the genetic structure of populations. Local seed dispersal will determine the extent to which populations will be subdivided into neighborhoods increasing the opportunity for local adaptation and genetic drift. Long distant seed dispersal maintains connectivity among sites either on an ongoing or intermittent basis. In this paper, we will examine seed dispersal of California valley oak using a genetic structure analysis of dispersed seeds and seedlings found in a natural savanna setting to address the following questions. (1) What is scale of dispersal for locally dispersed seeds? (2) Is there evidence of long-distance seed dispersal within the study site? (3) What is the pattern of spatial autocorrelation in dispersed seeds versus seedlings and what does this indicate about the neighborhood size after the two life history stages? To address these questions, we will use data from seven microsatellite nuclear genetic markers for approximately 250 individuals. Our results indicate that the majority of seed dispersal is extremely restricted in this species, which results in small effective neighborhood sizes. We suggest that these results are a reflection of an optimal foraging strategy and territory size for the dispersal agents. Our findings also include occasional long-distance seed movement, however, pollen movement might be much more effective at genetic connectivity than seed movement for fragmented populations. We will discuss the consequences of contemporary gene movement in temperate and tropical oaks in the face of current environmental changes.

15:40 Understanding limits to pasture recolonization in a fragmented tropical dry forest: a case study of the tropical live oak *Quercus oleoides* with implications for restoration

Jeffrey A. Klemens[1], Nicholas J. Deacon [2] and **Jeannine Cavender-Bares [2]**
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Although regeneration of TDF is generally believed to be robust in the absence of fire, little is known about the factors that limit the return of particular species, particularly animal-dispersed species of mature-phase forest. Here we present a case study of the lowland tropical live-oak, *Quercus oleoides. Q. oleoides* is an atypical TDF species in that it is evergreen, ectomycorrhizal, and once formed monodominant stands across Guanacaste province, Costa Rica. Its potential to recolonize abandoned pastures within its former range, however, appears to be limited compared to deciduous TDF species. We summarize the results of a series of observational and experimental studies designed to measure current patterns of seedling establishment and to distinguish between three major hypotheses proposed as explanations for the lack of oak forest recolonization: a failure to satiate local seed predators, harsh abiotic conditions or intense competition from introduced grasses in regenerating pastures, and an absence of appropriate mycorrhizal symbionts in the pasture. While significant natural regeneration is apparent in the oak understory, we found a lack of recolonization in adjacent pastures.

Germination, survival and growth of planted seeds was as high or higher in the pasture than in the forest. Hence, these hypotheses are insufficient to explain recolonization failure. An alternative explanation is that dispersal limitation is preventing oak propagules from arriving in the pasture environment. In this system *Q. oleoides* may rely heavily on the behavior of a single mammalian seed disperser: the central american agouti, *Dasyprocta punctata*. Although *D. punctata* is known to move acorns long distances, it is unlikely to cache seeds in pastures. These results provide insight into possible restoration strategies for the oaks of Guanacaste Province. Given seedling success near existing oak patches, direct planting of seeds or seedlings may be sufficient to greatly accelerate the pace of recolonization.

Keywords: Quercus oleoides, regeneration failure, tropical dry forest, ectomycorrhizae, forest-pasture ecotone

16:00 Ecology and restoration of *Quercus*-dominated tropical montane forests of Central Chiapas, Southern Mexico

Mario Gonzalez-Espinosa[1], Neptali Ramirez-Marcial[1], Luis Galindo-Jaimes[2], and Angelica Camacho-Cruz[2]
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A large number of *Quercus* species (ca. 25) are dominant elements of the canopy of highly diverse Tropical Montane Forests in Chiapas. These forest formations have been severely impacted by centuries of human activities. The total tree species richness associated to *Quercus* is a useful reference target for forest restoration actions aimed to conservation of biodiversity and the sustainable use of timber and non-timber forest resources. We identify and discuss a relatively recent induced pine-rise of native *Pinus* species in sites where *Quercus* dominated forests were formerly more extensive. This pine-rise emerges as an alternative successional routle leading to an arrested state along the series triggered by traditional shifting agriculture and its modern derivatives. Experimental data and observational evidence on species recruitment and replacement collected along environmental gradients and in forest stands that differ in their structure and composition, similar to those associated to secondary succession, point to the potential role that *Quercus* species may play as a tree functional group in the design and implementation of restoration practices in highly diverse Tropical Montane Forests.

Keywords: forest fragmentation, shade tolerance, drought tolerance

18 Liana symposium

WEDNESDAY, JULY 18
Room 4: Sala Rectores (Second Floor)
Building: Centro Cultural Universitario

Organized by:

- Diego R. Pérez **.**, Centro de Investigaciones en Ecosistemas, UNAM
- Stefan Schnitzer, University of Wisconsin - Milwaukee

Lianas are climbing plants that depend on the physical support of other plants to reach the top of the canopy. Lianas are conspicuous component of tropical forests, but they are also present in temperate ecosystems. In a recent workshop organized by Schnitzer and Burnham, twenty ecologists from the four continents dedicated to the study of lianas gathered to share information and produce collaborative manuscripts. In this symposium, we expect to report on some of those collaborations, and invite other ecologists to present recently acquired information on lianas in tropical forests.

14:00 Liana and tree responses to hurricane damage in Cozumel, Mexico

Pérez-Salicrup, D. R. and **Patiño-Conde, P.**
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Hurricanes constitute a major source of disturbances in the Caribbean Islands and the Yucatan Peninsula. These events have a return period that ranges between 8 and 15 years. Lianas are climbing plants that depend of the support of other plants to reach the forest canopy. Lianas usually become abundant in disturbed habitats, and might also have negative effects on trees. In this study we evaluated the composition and structure of the liana and tree communities in Caribbean Island of Cozumel, off the coast of the Yucatan Península before and two consecutive years after it was hit by two hurricanes. In July of 2004, we established 10 circular plots of 1000 m2 in which we measured all trees and lianas of different diameters following a stratified method. In June and October of 2005, Cozumel Island was hit by hurricanes Emily and Wilma, respectively. As result from the hurricanes, most trees lost parts of their crowns, and most lianas fell to the ground. Tree mortality was of 10%, and was concentrated in the 5 10 DBH class. Two years after the hurricane, most trees had been recolonized by lianas. Lianas of the genus Arrabidaea produced new leaves and shots along the stems, while Serjania yucatanensis produced many new climbing sprouts. Because most trees survived the hurricane, and mortality was related to size rather than to species, dominance of the tree community remained unchanged. Dominance of lianas, on the other hand, changed as result of an increase in numbers of some species with vigorous resprouting. Our data support the notion that vegetation in Caribbean Islands and in the Yucatan Peninsula is very resilient to hurricanes, and that at least the structure of the liana community might be driven by these events.

Keywords: disturbance, forest structure, hurricanes, lianas, trees

14:20 Do lianas alter the relative success of tree species during regeneration?

T. Toledo-Aceves[1] and **M. Swaine**[2]
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After colonizing gaps, lianas can remain installed for several years, delaying the forest succession. Their effects on tree regeneration through competition could modify tree species capacity to establish. The central questions are: Do lianas alter the relative success of tree species during regeneration? Are the effects of lianas on tree seedlings moderated by the canopy openness? How are patterns of biomass allocation in tree seedlings affected by liana competition? To answer these questions seedlings of the trees Nauclea diderrichii (pioneer), Khaya anthotheca (non-pioneer light demander) and Garcinia kola (non-pioneer shade bearer) were planted with the lianas Acacia kamerunensis (fast growing) and Loeseneriella rowlandii (slow growing) in large and small gaps (~15% and 8% PAR respectively) and in the forest understorey (~4% PAR) in a tropical moist semi-deciduous forest in Ghana. In order to disentangle the contribution of the above and belowground competition a shade house experiment was carried out. Both root and root-shoot competition significantly reduced relative growth rates in all three tree species. Canopy openness moderated the interaction between liana and tree seedlings. The nature of the interaction was both liana and tree species specific and displayed temporal variation. Acacia competition effects were stronger in sites with greater canopy openness. In big gaps, Acacia reduced significantly the biomass of the tree seedlings by 38% regardless of species and reduced Khaya growth in leaf area five times, while Nauclea and Garcinia were not affected. Acacia was more plastic than Loeseneriella in response to the environment and the tree species. Our results show that while Loeseneriella, with lower rates of growth, did not affect seedling growth of the three species evaluated, Acacia through competition could modify tree species capacity to establish. Effects by lianas at the regeneration phase may have important implications for forest management.

Keywords: competition, gaps, regeneration, woody climbers

14:40 Liana diversity and distribution in tropical forests of southern Eastern Ghats, India: a landscape approach

C. Muthumperumal and **N. Parthasarathy**
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As part of a major research project concerned with landscape-level bioresources assessment of southern Eastern Ghats of India, we present the preliminary results of liana inventories carried out in two hill forests viz., Chitteris (11º 44' 12º 10' N; 78º 15'78º

45' E) and Kolli hills (11º 10' 11º 30' N; 78º 15'78º 30' E). These sites harbor five major forest types-tropical wet evergreen, semi-evergreen, mixed deciduous, dry deciduous and thorn forests. The specific objectives are to determine species richness, abundance and distributional patterns of lianas 1.5 cm dbh and to assess their bioresource values. The entire stretch of southern Eastern Ghats (10º.93'-12º.18' N) was divided into 6.25km X 6.25 km grids and within each grid a 0.5 ha transect (5m X 1km) was marked and further sub- divided into fifty 5m X 20m units to facilitate the inventory. A total of 46 transects were completed in the Chitteri and Kolli hills. The liana abundance totaled 14,353 individuals representing 115 species in 86 genera and 37 families. The predominant liana families (based on the species richness) include Asclepiadaceae (14 species) followed by Oleaceae (8 species), Apocynaceae, Menispermaceae, Papilionaceae, Rhamnaceae (7 species each), Convolvulaceae and Verbenaceae (6 species each). The most abundant liana species include Pterolobium hexapetalum (Caesalpiniaceae), Acacia caesia, A. pennata (Mimosaceae), Jasminum angustifolium (Oleaceae), Ziziphus oenoplia (Rhamnaceae), Secamone emetica (Asclepiadaceae), Ventilago maderaspatana (Rhamnaceae), Cansjera rheedii (Opiliaceae), Capparis sepiaria (Capparaceae), Grewia rhamnifolia (Tiliaceae) in Chitteri hills and Embelia basaal (Myrsinaceae), Gnetum ula (Gnetacae), Zanthoxylam ovalifolium, Z. limonella (Rutaceae) and Diploclisia glaucescens (Menispermaceae) in Kolli hills. The predominant climbing mode in these forests is twiners, followed by stragglers, tendril climbers, hook climber and root climber. The distribution of liana species is mapped and their bioresource values documented. Such data are expected to be useful for forest management and conservation of the understudied Eastern Ghats region of India.

Keywords: liana diversity, forest types, management

15:20 Are lianas better than trees at colonizing treefall gaps as seeds or seedlings?

Vargas-Timchenko Marta[1], Muller-Landau Helene[1] and **Wright S. Joseph[2]**
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Lianas (woody vines) are an important and poorly understood component of tropical forests. Lianas are particularly abundant in disturbed areas such as treefall gaps. We are interested in understanding the mechanisms in which lianas colonize treefall gaps, specifically in whether lianas are more successful at arriving in gaps as seeds or seedlings than trees. We compared the abundance of seeds from lianas relative to those from non liana woody plants arriving in seed traps located in gap and forest understory environments in the 50 ha plot in Barro Colorado Island, Panama. We also compared relative abundance of liana seedlings in gaps and the understory, and examined differences in arrival and recruitment with respect to dispersal mode. There was no difference in the relative abundance of seeds or seedlings of lianas in gaps compared to the understory compared to trees. We expect vegetative growth to play an important role in liana gap colonization.

Keywords: lianas, seeds, seedlings, treefall gaps

15:40 Liana dynamics in a subtropical montane forest of north-western Argentina

Agustina Malizia
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In a subtropical montane forest of north-western Argentina (27ºS, 1000 m elevation), I studied the liana community in a 6-ha permanent plot. (1) I recorded 2408 liana individuals 2 cm diameter belonging to 12 species and 10 families. Lianas were either wind or animal-dispersed. The most common climbing mechanism was scrambling with forked-stems or hooks /spines, and to a lesser extent the use of tendrils and voluble stems. Liana diversity and abundance was higher in NE-E facing slopes with drier, warmer and brighter microenvironments conditions. (2) I recorded 2320 host trees 10 cm dbh of which 65% hosted at least one liana stem. Large and well-lit trees had higher frequency and abundance of lianas. Foliar phenology and tree species identity did not show associations with lianas. Liana density showed a positive autocorrelation at spatial scales up to 40 m suggesting that the liana community is mostly structured by factors such as canopy access or canopy disturbances. (3) Lianas species using tendrils, spines / hooks and voluble stems showed higher densities within treefall gaps surrounded by a higher number of recent gaps (three to eight years old). Although gap age, aspect and openness were related to liana density and richness, the most imoportant factor influencing liana density and richness was the number of recent gaps in the surroundings; indicating that the spatial context of gap formation is particularly important on lianas composition and diversity, probably by increasing propagules input and the availability of small trellises for support. Overall, this study indicates that the liana community within this plot shows a topography-related spatial structure at the scale of hectares and tends to have a neutral dynamic where spatial factors are more important in determining regeneration than niche gradients provided by host trees and treefall gaps.

Keywords: liana spatial distribution, liana-tree associations, treefall gap dynamics, montane forests, Yungas

16:00 The role of lianas in treefall gaps: results from an eight-year liana removal experiment

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Lianas are a key component in tropical forests, where they can play a large role in forest regeneration and dynamics. Lianas may substantially reduce tree growth, recruitment and survivorship, especially in treefall gaps, where they are particularly abundant. The role of lianas in gaps, however, has never been tested experimentally. In 1998, we removed all lianas in nine randomly selected treefall gaps on Gigante Peninsula, a secondary forest located adjacent to Barro Colorado Island in Panama, and we

compared tree relative growth rate (RGR), recruitment, and mortality of all trees (> 1.3 m tall and > 3 mm in diameter) to nine control gaps, where lianas were undisturbed. We censused all 18 gaps six times over an eight-year period (1998, 1999, 2000, 2001, 2003, and 2006). Tree RGR was consistently higher in liana-removal gaps in every sampling period. Tree sapling recruitment over the eight-year period was 32% higher in liana removal gaps compared to control gaps. Tree mortality, however, did not differ among the two treatment types. Combined, total sapling accumulation (recruitment minus mortality) was 48% higher in the liana removal gaps than in the control gaps over the eight-year period. Our data demonstrate that lianas impact gap-phase regeneration primarily by restricting tree recruitment and substantially reducing tree growth rates.

Keywords: canopy gaps, forest dynamics, lianas, regeneration

16 Part II Ecology of coffee agro-ecosystems

WEDNESDAY JULY 18
Room 5: Aula Mater (First Floor)
Building:Colegio Primitivo de San Nicolás de Hidalgo

Organized by:

- Peter Hietz, Institute of Botany, University of Natural Resources and Applied Life Sciences, Vienna, Austria

14:00 Agroforestry and environmental services

Lorena Soto-Pinto, Manuel Anzueto-Martínez and **Marcela Delgadillo**
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Atmospheric carbon dioxide concentration increases rapidly causing impacts on the ozone layer and earth temperature. Agroforestry has a potential for carbon sequestration, whereas offers benefits to local people. This research quantified carbon reservoirs in agroforestry systems (AFS) established by Solel'te project, in Chiapas, Mexico. Fifty eight plots were inventoried in 7 localities on a climatic gradient between 200 and 1500m a.s.l. Total carbon (Ctot) was estimated using allometric formulas in the following reservoirs: live biomass (BIOM), dead organic matter (DOM) and soil organic matter (SOM). Cluster analysis and principal components were run in order to identify groups of plots and dependable variables, for cluster III stepwise regression, ANOVA and Duncan's multiple range tests were carried out. Plots were grouped in four associations for climatic zones. In the first group plots taungya and improved fallow were associated (200m a.s.l. hot-humid); in the second groups taungya, improved fallows and coffee plantations in the low-intermediate zone (700-850m a.s.l semi-hot humid); in the third group improved fallows, traditional fallows, traditional milpa, taungya and coffee plantations in the high-intermediate zone (1000-1200m a.s.l semi-hot sub-humid). Altitude, SOM, Ctot and BIOM were the variables responsible for 99.5% of variation.
SOM was the highest C reservoir with more than 70% of total soil carbon, the first soil layer contains the highest amount (decreasing with depth; R^2=0.97) and may be conserved if AFS's are maintained for the long term. Intervened AFS's accumulated higher average amounts of Ctot than traditional systems and additionally offer social and economic benefits in the short time. All systems seem similar in C content, except milpa. Taungya, which is a milpa with trees and improved fallow are higher in C content and seem a good option for carbon sequestration and obtaining economic benefits. AFS's are diverse and may offer a second environmental service, biodiversity conservation.

Keywords: agroforestry systems, carbon sequestration, environmental services, improved fallow

14:20

Epiphyte diversity and colonization in coffee plantations

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In some areas with high forest loss, coffee plantations with shade trees represent the most important arboreal vegetation and a potential refuge for epiphytes and other canopy organisms. In central Veracruz, Mexico, the number of epiphytic species in traditional coffee plantations with old shade trees was about as high as that in forests, but young plantations with mainly small trees hosted fewer epiphytes than those with large trees. Comparing different sites showed that epiphyte communities were more homogeneous in coffee plantations than in forests. To investigate which factors limit some epiphytes to closed forests, we studied seed germination of three bromeliads (Tillandsia spp.), and seedling survival and growth of the bromeliads and two orchids that differ in their ability to colonize coffee plantations, comparing three forests, three old and three young coffee plantations. Although germination rates of the species restricted to forests was highest in forests and those of a xeric species and rapid colonizer were highest in young coffee plantations, old coffee plantations were not intermediary but had the lowest germination rates.

Keywords: coffee plantation, epiphyte, germination, colonization

14:40 Persistence of a predator population: indirect benefits of ant-attendance to a green scale predator in a coffee plantation

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I am studying the mutualism between an important coffee pest, the green scale (Coccus viridis, Hemiptera: Coccidae) and an aggressive tree-nesting ant, Azteca instabilis (Hymenoptera: Formicidae) in a coffee agroecosystem in Chiapas, Mexico. My research focuses on the interaction between this mutualism and a voracious green scale predator, the ladybeetle Azya orbigera (Coleoptera: Coccinellidae), whose larvae have waxy filaments that render them immune to ant attacks and thus are able to prey upon ant-tended scales. I wanted to determine if A. instabilis' patchy distribution creates high- and low-quality habitats for A. orbigera, and if this spatial heterogeneity influences A. orbigera's distribution and population stability. During the dry and rainy seasons, I performed two samples of A. orbigera in an established 45-ha plot. During the rainy season, I found statistically more larvae, pupae, and adults around trees with ant nests. Furthermore, the larvae were more heavily parasitized in sites without ants and the larvae:pupae ratio was statistically greater around trees without ants. Additionally, I conducted field and laboratory experiments and determined that by living in plants with

patrolling ants, the ladybeetle larvae gain partial protection against their natural parasitoids. The influence of A. instabilis on A. orbigera's distribution was more dramatic during the dry season, when A. orbigera's populations were drastically reduced and were almost exclusively found around trees with ants. My results suggest that, besides having access to high prey-density areas, A. orbigera larvae gain enemy-free space by living in ant-tended areas. Consequently, the A. instabilis-C. viridis mutualism appears to be key to the persistence of A. orbigera's populations, which in turn, might be crucial for the natural control of green scales in coffee plantations. It is worth noticing that due to the tree-nesting nature of A. instabilis, these interactions are only possible in shade-grown coffee plantations.

Keywords: natural pest control, coffee, mutualism, ants, predators

15:20 Bee diversity within coffee agro-forestry systems: land management mediates community structure

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A number of studies have suggested that native bee diversity and abundance are influenced by local landscape composition. However, few studies have examined the specific parameters that mediate tropical native bee diversity and abundance within a local landscape. Tropical agro-forestry systems are ideal systems for the study of bee diversity because they are uniform across large expanses of land, yet still exhibit varying styles of land management. In this study, I conducted extensive pan-trapping experiments across seven different coffee agro-forestry systems in Chiapas, Mexico. Results across sites indicate that bee abundance and diversity varied across the sampling season, with the greatest bee diversity and abundance occurring at the peak flowering time of the under-story plants. Bee abundance was significantly higher in the agro-forestry sites with greater overstory tree density and greater over-story tree basal area. Bee diversity positively correlated with the diversity of under-story plants as well as the density and basal area of over-story trees and negatively correlated with the density of coffee plants. These results indicate that management of both canopy-level and ground-level vegetation in tropical coffee agro-forestry systems directly influences the availability of bee pollinators. Pollination studies conducted on native plants at the time of trapping also suggest that agro-forestry management influences pollinator services available for native plants living within the agro-forestry system.

Keywords: bee, diversity, coffee, Mexico, foraging

15:40 Seedling establishment of epiphytes in coffee plantations and forests

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Coffee plantations with shade trees can be an important refuge for epiphyte diversity, but do not appear to be suitable for all species. At nine sites belonging to 3 different habitat types (natural forests, old coffee plantations and young coffee plantations) we transplanted a total of 6120 seedlings of two orchid and three bromeliad species with varying ability to colonize shade trees in coffee plantations. Contrary to our expectations, the orchid species restricted to forests (*Lycaste aromatica*), had lower mortality rates than the colonizer *Jacquiniella teretifolia*. In both species, mortality was highest in old coffee plantations and, surprisingly, lowest in young coffee plantations. The percentage of newly formed ramets in *J. teretifolia* was highest in coffee plantations and lowest in forest sites, whereas the opposite is true for seedling growth of *L. aromatica*. Our results indicate that the differential colonizing ability of epiphytes might be the consequence of higher seedling growth rates of colonizing species whereas seedling mortality seems to be less important.

Keywords: epiphytes, coffee plantation, colonization, seedling establishment

#19 Natural Services in local context: Opportunities and barriers to uptake

THURSDAY JULY 19
Room 1: Teatro José Ruben Romero
Bulding: Teatro José Ruben Romero (Auditorium)

Organized by:

- Julia Born, Ecosystem Management. Institute of Terrestrial Ecosystems. Department of Environmental Sciences, Zurich, Switzerland
- Virginie Boreux, Ecosystem Management. Institute of Terrestrial Ecosystems. Department of Environmental Sciences, Zurich, Switzerland
- Smitha Krishnan, Ecosystem Management. Institute of Terrestrial Ecosystems. Department of Environmental Sciences, Zurich, Switzerland

An ecosystem service approach has become the new paradigm for conservation. The management of human dominated yet complex landscapes is crucial for conserving the remnants of biodiversity which might play an important role in providing ecosystem services. In recent years there have been dramatic advances in economic and ecological research on ecosystem services. Yet there has been little practical transfer of the immense scientific research output to the decision makers, the local community. So what are the barriers of uptake at the local level? How do we overcome these barriers? Does an ecosystem approach provide realistic opportunities for integrating land use and conservation objectives?

10:00 Strategies and practical tools for integrating local stakeholders into conservation and resource-use research

Karen A. Kainer[1], Maria DiGiano[1], Amy Duchelle[1], Emilio Bruna[1], Jonathan Dain[1] and **Lucia H. O. Wadt [2]**
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Many scientists studying tropical conservation consider the scientific process complete once findings are published; indeed publications are central to fundraising and career advancement. As a result, stakeholders who reside in biodiverse and resource-rich ecosystems like tropical forests have often been neglected during the research process. However, local communities are becoming an increasingly important stakeholder in resource management and conservation efforts, particularly in the developing world. For example, ~25% of tropical forests are owned or managed by communities, and this figure is likely to increase considerably in the coming decades. While there is little evidence to date that communities are optimal land stewards, it is also unlikely that forests will be conserved without engaging those who depend directly on them for survival. We explored barriers investigators often face in integrating local communities and organizations in their conservation and resource-use research. We argue that a key hurdle to doing so is that many researchers simply do not know how to go about developing a research

program that integrates local stakeholders at different stages of the research process. We also present a brief historical synopsis of early efforts to integrate local learning and research, many pioneered by investigators and institutions focusing on small-scale agricultural development. We then review strategies and practical tools developed by academics, graduate students and other scientists for making their conservation and resource-use research programs more locally responsive. These include mechanisms to engage communities in participatory research and return findings in formats that enhance learning. For example, community-based venues create a comfortable space where local people are on their home turf and in critical mass; appropriate interactive tools include storyboards, maps, photographs and flipcharts. We close with an analysis of how these approaches might be institutionalized in settings where greater integration of local stakeholders in the research process is essential.

Keywords: community, dissemination, returning results, participatory research

10:20 Conserving biodiversity and services from tropical ecosystems: synergy or conflict?

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Increasing awareness on connections between biodiversity, ecosystem services and human well-being have shifted conservation emphasis from focus on biodiversity only to protection of the delivery of ecosystem services. Although this approach seems promising, questions still remain whether they will coincide and reinforce each other or rather contribute to conflicting management strategies. Such a question is particularly relevant for the highly diverse tropical systems that provide crucial ecosystem services to local populations and to the whole planet. Here I analyze potential synergy or conflict between biodiversity and ecosystem services based conservation approaches, with emphasis on tropical systems, from three different perspectives. The first one is the conceptual basis for potential synergy of conflict. Biodiversity plays a crucial role in ecosystem functioning and thus the delivery of ecosystem services; while increasing amount of evidence points to clear positive relationships between them, very little of such evidence is available for tropical systems. The second one is their potential spatial coincidence at the landscape scale, within human dominated areas. Agroecosystems promote the delivery of provisioning ecosystem services at the expense of regulating or supporting ecosystem services and sustain only a biased fraction of biodiversity; instead, simultaneous management for multiple non-timber forest products or for the delivery of ecosystem services such as water provision or may contribute to the conservation of elevated biodiversity. The third one is the analysis of synergy or conflict based on socio-economic drivers of ecosystem change such as economic incentives and cultural perceptions. Economic incentives directed at the payments for regulating ecosystem services may promote conservation of biodiversity, but not in all cases. Cultural perceptions commonly include provisioning services, some regulating services and often exclude supporting services and associated biodiversity. We conclude that biodiversity and ecosystem services centered conservation approaches may be complementary and potential for synergy must be reinforced.

Keywords: biodiversity, ecosystem services, tropical systems

10:40 Conflicts over natural resources in the Western Amazon: implications for community forest management of non-timber forest products

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Forest management decisions are strongly influenced by security of forest property rights, and best long-term management practices often hinge on strengthening control over forest resources. Brazil nut (Bertholletia excelsa) is the most important non-timber forest product (NTFP) in the tri-national region of Pando, Bolivia, Acre, Brazil and Madre de Dios, Peru. This species simultaneously promotes forest conservation and forms the livelihood base for rural communities. The current development of the Interoceanic highway, an extension of the recently paved Brazilian BR-317 into Bolivia and Peru, will change the nature of this formerly remote region by providing regional access to Pacific ports. Within this dynamic context, it is essential to understand how property rights security affects short and long-term Brazil nut management in order to envisage the future of this important NTFP. We evaluated Brazil nut collection and management practices in twelve communities in Bolivia and Brazil by conducting interviews with extractivists and accompanying Brazil nut harvests in 2006 and 2007. Results of this comparative study show that the central role of Brazil nut in the Pando household economy, coupled with unclear property rights, creates an extremely high degree of conflict during the harvest season. Such conflict affects both the timing of Brazil nut collection, as well as management of the resource. Conversely, a more secure land tenure system in Acre that reflects the concept of traditional tree tenure, along with the availability of diverse livelihood options, have resulted in less conflict. Participatory mapping can be used as a tool for communities to deal with tenure conflict, visualize traditional forest use systems, and leverage integration of traditional practices into formal land titling processes and decision-making.

Keywords: NTFPs, community forest management, land tenure, conflict, Amazon

11:20 Integrating the eco-service approach and models on social decision making in humans

Claudia Rutte
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The problems in conservation biology are often not of biological nature but arise from social dilemmas. We therefore need to study human behaviour in social dilemmas to solve problems such as climate change, overexploitation of natural resources, and pollution. Because human behaviour is difficult to model, empirical and experimental approaches are required to help to solve existing conservation problems. The eco-

service approach can produce important facts that affect the decision makers in certain ways, if communicated to the local communities. Game theory as a powerful tool to study social decisions in humans could be applied to analyse how cooperative outcomes can be achieved in a given socio-economic situation. Beside theoretical considerations, I will discuss some examples from my field work in South India where I am studying community-based management of sacred groves in Kodagu district of Karnataka.

Keywords: eco-services, human cooperation, game theory, community-based management

11:40 Fostering partnerships between regional government and science

Meg Lowman
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What will your community look like in the year 2050? Getting involved in regional government as a scientist is one important way to shape that outcome. A growing cadre of biologists are serving their local communities by bringing science into regional decision-making. In this presentation, I describe ways to become involved with regional policy as a biologist. Activities range from writing newspaper columns to serving on planning boards; from leadership in science education to engaging citizen scientists; and from training with the Aldo Leopold Leadership Program to joining your local Economic Development Corporation. In Florida, the challenges of land use and climate change represent good examples where professional ecologists need to be at the table with developers, businessmen, and policy-makers. Biologists of the next generation will require new training in public outreach, new job descriptions encouraging effective communication of science to policy-makers, and skill sets to play effective roles in regional decision-making. Given the high carbon emissions of air travel, working locally may become the most ethical choice for many conservation practitioners.

Keywords: policy-makers, local government, ecosystem services, land use, human ecology

12:00 Transfer of ecological knowledge between local communities, administrations and experts: barriers and uptakes at local level?

G. Kushalappa Cheppudira[1] and **Claude A. Garcia** [2]
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[2]CIRAD, Forest Resources and Public Policies Research Unit / French Institute of Pondicherry
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The transfer of the management of natural resources to local populations normally involves the development of monitoring systems. Designing such a system based on local criteria and indicators (C&I) means combining scientific expertise with traditional knowledge. There are numerous methods developed to merge these two branches of

knowledge, but the difficulty lies in implementing and transferring those monitoring systems at the local level.

The district of Kodagu, in the Western Ghats of India, harbours more than one thousand sacred forests (devarakadus). In December 2001, the Government of Karnataka adopted the Joint Forest Management Plan for the devarakadus, thus creating Management Committees at the village level. These newly formed local institutions lacking in resources, know how and practical skills for forest ecosystem management yet having responsibilities over them, provided us with the opportunity for developing such an indicator-based system.

We based our approach on three aspects: facilitation of the formulation of management objectives, (i), identification of pre-indicators, the informal vectors thus far utilised for collating decision-enabling data (ii) and co-construction of the toolset, to ensure final appropriation by the end-user. The final proposal relied on knowledge of the local communities, validated by scientific expertise to achieve balance between ecological and social relevance and was adapted to the available human, material and organizational resources. However, the toolset was not successfully transferred. Unless the transfer of power, duties, responsibilities and benefits to the local populations is real and lasting, no amount of traditional and technical ecological knowledge can make participative management of natural resources a reality. Drawing lessons from this, a new strategy has been developed. The Kodagu Model Forest Programme is an attempt to implement sustainable natural resources management under the International Model Forest Network initiative. Through a series of interactions a strategic plan for the different components has been proposed.

Keywords: Criteria and Indicators, local monitoring, Participative management, Tropical forests, knowledge transfer

20 Part I Seed dispersal and seed predation in Neotropical palms

THURSDAY JULY 19
Room 2: Conservatorio de las Rosas (Auditorium)
Building: Conservatorio de las Rosas

Organizer by:

- Patrick A. Jansen, Community and Conservation Ecology University of Groningen, the Netherlands
- Kirsten M. Silvius, Gordon and Betty Moore Foundation, San Francisco

Palms are a dominant life form in many Neotropical forests. Their fruits often represent an important food resource for frugivores and granivores, which act as dispersers and/or predators of palm seeds. This symposium aims to present recent work on interactions between palms, frugivores and granivores. We will invite people studying aspects of palm seed dispersal, seed predation and seedling recruitment. We aim for a 10-12 talk state-of-the-art symposium with strong coherence and a logical thread, starting with talks on specific interactions and finishing with talks on palm-centered food webs. A second aim is to stimulate co-operation among the participants and their research groups.

10:00 Bruchids as predators on palm seeds (Coleoptera: Bruchidae)

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Bruchids comprise approximately 66 genera and 1,700 species worldwide. Of these, more than half are known from the New World and the remainder spread on the rest of the world. Actually the family Bruchidae is divided into the subfamilies Amblycerinae, Bruchinae, Eubaptinae, Kytorhininae, Pachymerinae, and Rhaebinae. About 80% of bruchid species are in the Bruchinae, 10% in the Amblycerinae, 9% in the Pachymerinae, with the other 1% assigned to the other three subfamilies. All bruchid larvae feed in seeds and about 84¬% of bruchid species feed in the seeds of the Fabaceae. The others feed in the families Arecaceae (4.5), Convolvulaceae (4.5), and Malvaceae (2%). The remaining 5% feed in seeds of 35 other plant families. No all species of Pachymerinae are predators of seed palms; the tribes Caryopemini and Caryedontini are restricted to the Old World and feed mainly on seeds of Fabaceae and Combretaceae. All species commonly called palm bruchids are in the tribe Pachymerini, which is restricted to the New World. Some species of Pachymerinae are now cosmopolitan in their distribution. The Pachymerini is formed by the genera Caryoborus (3 species), Caryobruchus (6 species), Pachymerus (7 species), and Speciomerus (4 species). Some studies state that Pachymerini females lay eggs only in seeds where the exocarp and mesocarp have been removed, and larval predation may be up to 100%.
Using the BRUCOL data base (Romero & Johnson, 2004) it is known that Pachymerini may feed on seeds of 32 genera and about 110 species of Arecaceae family, with the

single exception of *Pachymerus abruptestriatus,* which feeds on *Dyospiros* sp. seeds (Ebenaceae).

keywords: Palm bruchids, hosts, predation

10:20 Phenology and seed predation in three species of palms

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The timing of fruit and seed production may influence seed survival via differences in abiotic and biotic conditions. Levels of seed predation may differ with time of dispersal for various reasons, including seasonal changes in predator abundance, and changes in the number of conspecific seeds produced. We examined how the timing of seed production influenced seed survival and germination of three species of lowland rainforest palms, *Welfia regia, Socratea exorrhiza*, and *Iriartea deltoide* in Costa Rica. We also compared timing of seed production and seed germination and survival of *S. exorrhiza* between a site in Panama with highly seasonal rainfall, and a site in Costa Rica with a relatively weak dry season. We expected that levels of seed predation would be influenced more strongly by time of seed production for the species that had more pronounced fruiting peaks (*S. exorrhiza*, and *I. deltoide*) than for *W. regia* which fruits throughout the year. We also expected larger differences in seed survival for *S. exorrhiza* between placement dates in the more seasonal site in Panama than in Costa Rica. Seeds of each species in Costa Rica were placed in the field during 24 different time periods that represented a low and high period of conspecific fruit production and survival and germination was monitored. In Panama seeds of *S. exorrhiza* were placed in the field during 2 periods corresponding to the start and the peak of *S. exorrhiza* fruiting. Although seed survival rates differed between placement dates, survival patterns were not consistent between predator type or palm species, and contrary to expectations, the greatest differences in seed survival time between placement dates were found for *W. regia*. Despite the seasonal differences between Costa Rica and Panama the rate of seed predation between placement dates was fairly similar at both sites.

Keywords: phenology, palms, seed predation, Costa Rica, Panama

10:40 Fruit handling by frugivorous vertebrates enables niche partitioning by granivorous beetles: small scale pattern detected by a landscape scale experiment

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Preliminary data from Barro Colorado Island, Panama, suggested that co-occurrence and relative population abundance of two sympatric bruchid beetles restricted to the same host palm species is mediated by vertebrate frugivore use of the palm fruits. A large

scale field experiment at Maraca Island Ecological Reserve, Brazil, confirms that the two bruchid species use the palm resource differently--*Speciomerus giganteus* is almost completely restricted to endocarps derived from fruits whose husk has been removed by vertebrates, while *Pachymerus cardo* occurs in those derived from both handled and intact fruits. Early in the fruiting season, paired vertebrate exclosures containing 30 intact and 30 handled fruits were placed at 4 replicate fruiting trees at each of 6 sites along a 10 kilometer ecosystem-and-palm-density gradient ranging from interior terra firme through edge forest, savanna forest islands and riverine forest. Endocarps were collected after 1 year and the exit holes left by emerging beetles measured. *Speciomerus* produces significantly larger exit holes than *Pachymerus*; exit hole size is not related to endocarp size. Exit holes were significantly larger for handled fruits than for intact fruits, indicating predominant use by the larger *Speciomerus*. Although there were significant site effects and site-by-fruit type interactions, niche separation was consistent across all habitats. Lab based experiments are needed to determine the mechanism for separation. If *Speciomerus* cannot use intact fruits in the absence of *Pachymerus*, then it would be excluded by *Pachymerus* at sites of low mammal abundance. *Pachymerus* is the dominant competitor, being able to use both forms of fruits. *Speciomerus* is more abundant than *Pachymerus* at BCI, while the opposite is true at Maraca, suggesting an over-abundance of small frugivorous mammals at BCI relative to Maraca.

Keywords: Bruchid beetle, niche-separation, competition, *Attalea*, frugivory

11:20 Seed density, dispersal and predation in an understory palm

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Rodents cache and consume seeds of *Astrocaryum gynacanthum*, an abundant understory palm, in lowland rain forests of the Caura River Basin, in southern Venezuela. I did several experiments with marked and unmarked seeds to examine the effect of seed density on seed caching and removal. Hunting in the study area may have very slightly reduced populations of agoutis, but did not impact acouchy, spiny rat or large felid populations during a period of at least a decade before this study. Seed caching was intensive toward the tail-end of a fruiting peak and then fell off sharply. Initial seed density in 1-m x 1-m plots did not affect rates of seed removal, but there was a trend toward lower proportions being removed from higher density plots. On plots of a range of sizes, from 0.5-m x 0.5-m to 12-m x 12-m, there was an inverse trend of disproportionately long caching distance with initial density. More unmarked seeds were taken from open sites than from paired sites accessible only to small rodents ($p = 0.01$), but time to discovery did not differ between access treatments. These results comport with caching models derived from other field sites. Manipulative experiments of much greater sophistication will be required in order to elucidate mechanisms behind seed caching and consumption.

Keywords: rodents,palms, seeds

11:40

Differential handling of palm seeds by Central American agoutis (*Dasyprocta punctata*; Rodentia) and collared peccaries (*Tayassu tajacu*; Artiodactyla) has contrasting effects on seed fates

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In neotropical forests, terrestrial mammals are important palm seed dispersers and predators. The positive (dispersal) and negative (predation) effects that mammals have on seeds influence tree propagation and forest regeneration yet little is known about how seed dispersers with different seed-handling strategies affect seed fates. Central American agoutis (*Dasyprocta punctata*) disperse seeds via scatter-hoarding whereas collared peccaries (*Tayassu tajacu*) consume and kill most of the seeds they find. The main goal of this study was to determine the effects that agoutis and peccaries each have on the survival of palm seeds at Estacion Biologica La Selva, Costa Rica and how scatter-hoarding by agoutis affects seed survival. I tracked individual threadmarked seeds of *Socratea exorrhiza* and *Astrocaryum alatum* over 34-day periods to determine their fates. Seeds were either exposed to only agoutis and small mammals (excluding peccaries) or to all terrestrial mammals. I also simulated agouti hoards and exposed seeds to invertebrate or vertebrate seed predators for 34 days. Seed removal was faster at depots open to all mammals but most *Socratea* seeds suffered predation by peccaries, whereas seeds in semi-permeable mammal exclosures survived longer and were more likely to be hoarded and dispersed by agoutis. Artificially-hoarded seeds escaped predation by invertebrates and vertebrates while exposed seeds suffered high beetle infestation or almost complete removal by mammals. Peccaries consumed most *Socratea* seeds present on the forest floor, however hoarding by agoutis may counteract the overall damage that peccaries and insects have on seed survival to germination.

Keywords: *Dasyprocta*, *Tayassu*, seed dispersal, seed predation, scatter-hoarding

12:00 Production and fate of *Astrocaryum mexicanum* seeds before and after hurricane Iris in southern Belize

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Astrocaryum mexicanum is an understory dominant palm species that is an important constant food resource for many mammals of all sizes. Before hurricane Iris (October 8, 2001), mean fruit production was 45.4 fruits per tree per year. After the hurricane, mean annual production exceeded 130 fruits per tree. This was due to a substantial increase in mean canopy openness (from <7% to 32% between July 2001 and March 2002) that is currently only slowly declining. Fruit production approached the pre-hurricane level in 2005. However, in 2007 fruit production appeared to be declining to about 60% of the pre-hurricane level. As canopy openness is still significantly higher than in the pre-hurricane years, this decline must be attributed to a physiological exhaustion of the

reproductive trees. In general, while >95% of seeds falling into exclosures below mature *Astrocaryum* trees either did not germinate or failed to produce viable seedlings because of desiccation or decomposition, seeds dispersed and buried under the surface by mammals, namely by *Heteromys desmarestianus*, had significantly higher survival rates. Removal rates and fate of A. mexicanum seeds were strongly related to abundance of *H. desmarestianus*. Because all other fruit production ceased for two years after the hurricane, density of *H. desmarestianus* decreased from 46 per ha in September 2001 to 23 per ha between January 2002 and January 2004. While this resulted in a 60% decline in removal rates of *A. mexicanum* seeds, the proportion that was eaten increased by 50% because no alternative foods were available. Seed removal rates and the proportion eaten returned to pre-hurricane levels as density of *H. desmarestianus* increased after fruiting non-*Astrocaryum* woody plants resumed in January 2004.

Keywords: *Astrocaryum mexicanum*, hurricane, seed production, seed fate, *Heteromys desmarestianus*

21 Part I Functional Ecology of Tropical Plant Communities

THURSDAY JULY 19
Room 3: Cervantes Saavedra (Second Floor)
Building: Colegio Primitivo de San Nicolás de Hidalgo

Organized by:

- Horacio Paz, Centro de Investigaciones en Ecosistemas, Universidad Nacional Autónoma de México
- Lourens Poorter, Forest Ecology and Forest Management Group, Centre for Ecosystem Studies, Wageningen University
- Louis Santiago, Department of Botany and Plant Sciences, University of California, Riverside
- Kaoru Kitajima, Department of Botany, University of Florida

The goal of the symposium is to discuss how functional analysis of species in complex tropical plant communities is allowing us to ask new questions and gain a greater understanding of the mechanisms that underlie patterns of plant community organization. By functional analysis, we mean multispecific comparative analysis of plant traits that describe how plants use resources and allocate them to growth, storage, defense, and physiological function. The symposium is divided in a morning session on shade tolerance, and an afternoon session on drought tolerance. During the past decades, shade tolerance has been the central paradigm to understand how species partition resource gradients. The morning session focuses on some new approaches (measuring the whole-plant light compensation point) and conceptual ideas (the importance of physical defenses for the growth survival trade-off, ontogenetic changes in light requirements). The afternoon session focuses on the rapidly developing field of water relationships, and its importance for drought tolerance and species distribution. We end with a discussion whether there is a trade-off between shade and drought tolerance, or whether these represent largely orthogonal axes, thus contributing to species coexistence and a high species diversity in the tropics.

10:00 Whole-plant light compensation points and the meaning and measurement of shade tolerance in tropical trees

Sean C. Thomas [1] and **Jennifer L. Baltzer**[2]
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The concept of "shade tolerance" was originally derived from applied studies on temperate forest trees, with shade tolerance classes reported being essentially subjective. The recent comparative literature on tropical forests has used a variety of "proxy-measures" of shade tolerance, including demographic, environmental, and physiological parameters. Here we make the case for explicit measures of the whole-plant light compensation point (WPLCP) -- estimated as the X-intercept of relationships

between tree growth and integrated measures of light availability -- as the most useful measure of the ability of trees to grow and survive under low light conditions. Our recent studies suggest that WPLCP corresponds closely to subjective shade tolerance classes in well-studied forest systems, that WPLCP for growth and survival are nearly identical, and that leaf dark respiration rates are the single most important physiological correlate of WPLCP in tropical trees. WPLCP also shows consistent variation with tree soil preferences in some cases, providing important insights into resource limitations on tree spatial distributions. We conclude that the WPLCP approach provides a critical tool to understanding a broad range of questions in the functional biology of tropical trees.

Keywords: shade tolerance, light compensation, dark respiration, plant resources, physiological ecology

10:20 Differences in whole-plant carbon gain between pioneer species in the early phases of secondary succession in tropical rain forest

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After large-scale disturbances in tropical rain forest, short- and long-lived pioneers (SLP and LLP, respectively) usually emerge at about the same time; however SLPs soon dominate the top of the canopy. What characteristics enable these SLPs to achieve early dominance and how are the LLP able to co-exist with their shorter-lived neighbors? To address this question we estimated whole-plant carbon gain of three SLP, four LLP and three liana species growing in 1/2, 2 and a 3 years old secondary forest stands. The SLPs Ochroma and Trema readily dominated the canopy and by the third year were more than two-fold taller than the other species. In the 1/2 y/o stand these two species had higher photosynthetic rates both in absolute terms and per unit leaf- (Pleafmass) and total mass (Pmass) than the other species. These greater Pmass and Pleafmass values were not so much correlated with a greater efficiency of light capture but rather with a greater photosynthetic light-use efficiency. This suggests that leaf physiological traits, that largely determine this light-use efficiency, are important in giving SLPs an early advantage. LLPs and lianas in turn had three-fold greater leaf longevities than the SLPs. Overall there was a strong negative correlation between Pleafmass and leaf longevity suggesting that traits that facilitate a high instantaneous efficiency in photosynthesis e.g. a high specific leaf area (SLA) or a high PNUE- are associated with low leaf longevity. The photosynthesis per unit leaf mass over the life of a leaf was slightly higher in the LLPs and lianas than in the SLPs. Coexistence between pioneer species during early phases of succession might therefore be associated with a trade-off between plant characteristics that confer a high instantaneous efficiency in photosynthesis and those that confer a long leaf lifespan.

Keywords: co-existence; competition; functional traits; secondar forest; restoration

10:40

Dynamic photosynthetic responses and light gradient partitioning

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Shaded environments are not uniformly dark, but punctuated by sunflecks, short bursts of bright light, that carry up to 90% of the photosynthetically active light that strikes plants. Sunflecks can account for up to 65% of total carbon gain in forest understories. Theoretically, understory plants should undergo physiological induction and open their stomata rapidly in response to sunflecks, and slowly lose induction and close stomata afterwards, while sun-adapted species should undergo induction more slowly and lose it more rapidly. Such patterns have been observed in a number of studies in both temperate and tropical forests. In almost every study to date, however, comparisons have only been made between two or three species, or two or three categories of species based on their relative distributions along a light gradient. Never has a quantitative relationship been drawn between measures of the light regimes inhabited by several species and the dynamic photosynthetic responses of those species. We used the Hawaiian lobeliads, which have radiated into habitats from open alpine bogs to shaded rain-forest, to examine the relationship of dynamic photosynthetic light responses to dynamic light regimes and to explore how dynamic responses influence daily leaf carbon gain. We found that the rate of photosynthetic induction increased significantly toward shadier sites. Uninduced light use efficiency – actual photosynthesis vs. that expected under steady-state conditions – increased from 10% to 70% across the same gradient. *In silico* transplants – modeling carbon gain using one species' photosynthetic light response in its own and an other species dynamic light regimes – demonstrated the adaptive nature of species differences: understory *Cyanea pilosa* in it's light regimes outperformed gap-dwelling *Clermontia parviflora,* while *Clermontia* in it's light regimes outperformed *Cyanea*. The apparent crossover in daily photosynthesis occurred at about the same PFD where dominance shifts from *Cyanea* to *Clermontia* in the field.

Keywords: Dynamic photosynthetic responses, light partitioning

11:20 Ecological benefits and costs of physical defense in tropical tree seedlings

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Tissue density and biomechanical strength are hypothesized to be important as functional traits underlying the growth-survival trade-offs widely observed among tropical tree species. However, direct quantitative tests of this hypothesis have been rare. Increased allocation to defense is expected to enhance seedling survival especially in low-resource environments where recovery from tissue loss would be slow, even if it requires growth rate reduction. Here, I summarize the results of recent studies that have quantified interspecific variations in tissue density and fracture toughness of seedling

leaves and stems, as well as modulus of elasticity (stiffness) of stems, for neotropical tree species from seasonal moist and dry forests. In all data sets, the wide variation in biomechanical strength among species is strongly correlated with tissue density and fiber contents. Seedlings that survive well in shaded understories are physically well defended with high tissue density in both leaves and stems, even very early in ontogeny. Tissue density and mechanical strength are positively correlated between stems and leaves, as well as between developmental stages, suggesting concordance of physical defensiveness between organs and ontogenetic stages. Leaf and stem density exhibited a stronger correlation with seedling survival than mechanical strength. Thus, high tissue density provides not only mechanical strength, but also additional ecological advantage for juvenile persistence in the shaded forest understory such as enhanced resistance against pathogens. However, these survival advantages of high tissue density and mechanical strength are apparently in a trade-off relationship with growth rates. Thus, mechanical defensiveness incurs a large opportunistic cost in resource rich environments such as treefall gaps. Possible reasons why slow growth associated with high physical defense include lower photosynthetic efficiency of thicker leaves, costs of allocation to fibers and support biomass, and slower developmental rates required for construction of dense and physically stronger tissues.

Keywords: biomechanics, physical defense, tissue density, trade-offs, tropical tree seedlings

11:40 Functional analysis of palm allometry: do morphological constraints determine palm distribution across light environments?

Gerardo Avalos [1,2], Gabriela Gei Maria [2], Mauricio Fernandez [2] and **Olivia Sylvester[3]**
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[2]The University of Costa Rica, School of Biology
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Palms represent one of the most conspicuous groups of Angiosperms in Tropical Forests. Although their contribution to overall species diversity is small, they influence forest structure and dynamics, and play an essential role in foodwebs. The distribution of palms reflects fine shifts in environmental heterogeneity and light availability. In arborescent species, adaptation to fine gradients is constrained by the capacity to increase in height and provide crown support while maintaining structural stability. The lack of a vascular cambium determines habitat colonization and resource allocation across gradients of light environments, influencing overall palm structure and architecture. We first analyzed the allometry of the stem height vs. stem diameter in eight neotropical palms representing a wide range of habitat and regeneration requirements across different successional sites in Costa Rica (Euterpe precatoria, Prestoea decurrens, P. acuminata, Geonoma edulis, Chamaedorea tepejilote, Cryosophila warscewiczii, Iriartea deltoidea, and Socratea exhorriza), and then evaluated overall palm structure by considering stem diameter, stem height, number of leaves, and the structure of the stilt root cone using a Principal Component Analysis (11 morphological variables). We found a strong logarithmic relationship between stem diameter and height. With the exception of the understory palms G. edulis and C. warscewiczii, shaded palms

under 1.5 m had significantly lower slopes relative to palms that escaped the light-limited understory, which grew 4-9 times faster. The first principal component (71.4% of the variation) had a homogeneous contribution of most of morphological variables, with the exception of the number of functional leaves, which dominated the second principal component (11.7%). Our results showed that species that differ significantly in size and light requirements shared a common solution to structural problems. Understanding these allometric relationships provides insight in determining how physical limits to morphological diversity influence the distribution and abundance of tropical palms.

Keywords: Tropical Forest, Palm Ecology, Costa Rica, Palm Allometry, Shade Tolerance

12:00 Are species adapted to their regeneration niche, adult niche, or both?

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Functional traits are important drivers of successional processes and the assembly of plant communities. It is generally assumed that functional traits are closely linked to the regeneration niche because of the high selection pressures in the seedling stage, but recent studies have challenged this view. In this study I use cross species and phylogenetic correlation analysis between leaf traits and light environment to evaluate whether species are adapted to the regeneration niche, adult niche, or both. Leaf chemistry, morphology, physiology and crown exposure were quantified for up to 58 Bolivian tropical moist forest tree species that differ in their regeneration and adult light niche. Multiple regression analysis shows that leaf traits of seedlings, saplings, and trees are most strongly related to the regeneration niche, and once that this is taken into account, adult niche does not significantly explain any of the remaining variation in leaf traits. This suggests that, although the regeneration phase is short, it has a long-lasting effect on the form and shape of plant species.

Keywords: adaptation, functional traits, light, maximal size, tropical rain forest

22 Pollination in Natural and Fragmented Communities

THURSDAY JULY 19
Room 4: Sala Rectores (Second Floor)
Building: Centro Cultural Universitario

Organized by:
- W. Scott Armbruster, University of Portsmouth

The pollination of tropical flowers occurs in the context of the plant and animal communities in which flowers occur, and thus plant-pollinator relationships are increasingly vulnerable to the effects of human disturbance of those communities. Yet successful pollination is essential for plant reproduction and hence for the maintenance of ecosystem stability and persistence, as well as for the services ecosystems provide. One of the most pervasive forms of community disturbance is fragmentation of tropical habitats. In this context, it is important to understand the sources of sensitivity to disturbance. For example, are specialized pollination relationships are more vulnerable to disturbance? Is this trend related to asymmetries in pollination food webs? This symposium brings together researchers addressing the stability and community ecology of pollination systems in natural communities and those investigating the effects of habitat fragmentation and related disturbances on plant-pollinator relationships.

10:00 Character displacement among bat-pollinated flowers of the genus *Burmeistera*: analysis of mechanism, process, and pattern

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Coexisting plants that share pollinators can compete through interspecific pollen transfer. A long-standing idea holds that divergence in floral morphology may reduce this competition by placing pollen on different regions of the pollinators bodies. However, surprisingly little empirical support for this idea exists. Burmeistera is a speciose neotropical genus that exhibits wide interspecific variation in the degree to which the reproductive parts are exserted outside of the corolla. Coexisting Burmeistera share bats as their primary pollinators, and the degree of exsertion determines the site of pollen deposition on the bats heads. Here we study the mechanism, process, and pattern of floral character displacement for assemblages of coexisting Burmeistera. Flight cage experiments with bats and pairs of Burmeistera species demonstrate that the greater the divergence in exsertion length, the less pollen transferred interspecifically. Null model analyses of exsertion lengths for 19 species of Burmeistera across 18 sites (each containing 2-4 species) demonstrate that observed assemblage structure is significantly overdispersed relative to what would be expected by chance. Local evolution, rather than ecological sorting, appears to be the primary process driving this pattern of overdispersion because local adaptation of the nine widespread species accounts for a large portion of the observed pattern. Taken together, results of this study provide strong

support for the idea that competition through interspecific pollen transfer can drive character displacement in plants.

Keywords: bat pollination, chiropterophily, floral morphology, competition, Ecuador

10:20 Vulnerability of the pollination systems of columnar cacti (tribe Pachycereeae) in arid and semiarid areas of Mexico

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Columnar cacti (tribe Pachycereeae) are one of the most conspicuous and important ecological groups of plants over vast areas of arid-semiarid regions of America. The group is distributed from Southwestern United States to Mexico, the West Indies and Northern South America, being south-central Mexico the area with the highest diversity. In this presentation, I synthesize the biogeographical, historical, and the ecological evidence concerning the pollination ecology of this group of plants in order to analyze the geographical patterns of specialization and therefore the degree of vulnerability to human disturbances. The results indicate that the early evolution of columnar cacti occurred during the Tertiary, linked with the evolution of nectar-feeding bats, the most important pollinators. Indeed, 72% of columnar cacti have a batflower syndrome, but the specialization to bat pollination seems to occur only within the tropics, whereas extratropical cacti are pollinated by a wide spectrum of animals including birds, bats and bees. This dichotomy found within and outside the tropics among columnar cacti with bat-pollinated flowers is explained as a consequence of the predictability of pollinators throughout the year. We hypothesize that geological events occurred at the end of the Tertiary period and the large climatic fluctuations occurred during the Quaternary were the most important scenarios that have contributed to the evolution of Pachycereeae and at the same time to the unpredictability of pollinator presence and the evolution of generalized pollination systems out of the tropics. The high degree of vulnerability of biotic interactions contributing to the maintenance of columnar cacti in tropical-dry communities is discussed in terms of cultural practices and human disturbances on nectarfeeding bats the most efficient pollinators and seed dispersers.

Keywords: Columnar cacti, nectar-feeding bats, tribe Pachycereeae, pollination biology, vulnerability to human disturbance

10:40 The ecology of "special" rewards in the tropics: plant-pollinator co-specialisation and web symmetry

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Most plants reward pollinators with nectar or pollen. In the tropics and subtropics, however, a significant proportion of plants offer alternative rewards. These include nutritive rewards, such as oils used by bees for larval provisioning and brood sites for rearing larvae, and non-nutritive rewards, such as fragrances and resin or waxes used by bees for mate attraction or nest construction, respectively. Studies of pollination webs and specialization have focused on nectar and pollen reward systems, largely concluding that generalization is common and that pollination webs may often be asymmetrical (specialist flowers are pollinated by generalist animals and specialist animals visit generalist flowers). This may lead to plants with specialized pollination systems being at no less risk to disturbance-induced extinction than plants with generalized pollination systems. Here I ask: does this pattern also hold for plants with special rewards? The answer seems to be no. Special rewards involve fewer kinds of animals and may lead to specialization; e.g. brood-site systems attract only a few taxa of wasps, moths, or beetles; floral oils attract a few genera of apid bees in the New World and melittid bees in the Old and New Worlds; floral fragrances attract only male euglossine bees (Apidae); floral resins and waxes attract only a few genera of megachilid and/or apid bees. Use of these special rewards by small sets of insect species engenders a degree of specialization in plant-pollinator relationships not seen in most nectar- /pollen-reward systems. There is ample evidence that, despite pre-adaptive origins, most of these systems are co-evolved, at least diffusely. In contrast to nectar and pollen systems, special rewards may often generate symmetrical pollination webs, leading to mutual dependency and greater risk of secondary extinction as a result of disturbance.

Keywords: bees, floral rewards, pollination, pollination-webs

11:20 Pollination, plant reproduction, and population genetics in fragmented habitats: facing theory with evidence

Ramiro Aguilar, [1,2], Mauricio Quesada[2], Yvonne Herrerias[2], Lorena Ashworth[1], Leonardo Galetto[1], **Jorge Lobo,**[3] and **Marcelo Aizen[4]**
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The loss and fragmentation of natural habitats by human activities are pervasive phenomena in terrestrial ecosystems across the Earth and the main drivers of current biodiversity loss. Throughout the last two decades fragmentation studies on plant populations have mainly focused on plant fecundity and plant-pollinator interactions. More recently, population genetic parameters have also been investigated in fragmented and degraded habitats. We quantitatively reviewed the results from fragmentation studies, with the aim of testing (I) whether pollination and reproduction of plant species are differentially susceptible to habitat fragmentation depending on certain reproductive traits that typify the relationship with and the degree of dependence on their pollinators, and (II) whether fragmentation is eroding the genetic composition of fragmented populations. We found an overall large and negative effect of fragmentation on pollination and on plant reproduction. The compatibility system of plants, which reflects the degree

of dependence on pollinator mutualism, was the only reproductive trait that explained the differences among the species effect sizes. Self-incompatible plants showed strong negative effects of habitat fragmentation on reproduction, whereas self-compatible plants were not significantly affected. Contrary to theoretical expectations, the effect sizes of plants with different degree of pollination specialization did not differ between them. Both, pollination specialist and generalist had large and negative effects of fragmentation. The overall genetic diversity of plants is negatively affected by fragmentation. No significant effects were found on inbreeding parameters in fragmented population. Allelic richness, in particular, decreased more strongly in self-incompatible species as a consequence of fragmentation. Surprisingly, most papers evaluating genetic effects of fragmentation have evaluated adult individuals in relatively new fragmented landscapes. We evaluate these results in the face of theory and propose possible explanations for the observed trends. Finally we discuss the conservation implications of these findings and give suggestions for future research on this area.

Keywords: Habitat fragmentation, Pollination, Plant reproduction, Conservation genetics, Plant-pollinatorinteraction

11:40 The effects of tropical forest fragmentation on euglossine bees in southern Costa Rica

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Given the importance of beesthe most important taxon of pollinatorsto both the persistence of native plant communities and the success of the human agricultural enterprise, it is imperative that we better understand their responses to ongoing global changes, especially in light of the lack of scientific consensus on putative pollinator declines. The euglossine, or orchid, bees (Hymenoptera: Apidae: Euglossini) are a tropical pollinator group of particular ecological salience, especially for long-distance transport of pollen between widely spaced individuals of low-density tropical plants. Despite being well studied relative to other groups of tropical bees, there are only three studies of the response of orchid bees to forest fragmentation; all were in Brazil and considered seven or fewer forest patches. To expand inference from these studies, I sampled male orchid bees with chemical baits over three months in 23 forest fragments in southern Costa Rica, ranging in area from 0.25 ha to 230 ha. Forest fragment area, isolation, landscape context, and elevation all affected euglossine bee communities, though not in a uniform or consistent manner. Orchid bees are more abundant in larger and less isolated forests, and in sites with greater proportions of nearby surrounding forest cover. Estimated species richness of euglossine bees is greater in forest fragments more than one hectare in area. Community similarity of orchid bees was related only to site elevation, when colinearity between site proximity and elevation was considered. The extensive dispersal abilities of euglossine bees likely help to buffer the effects of forest fragmentation on their species diversity, and allow them to utilize even the very smallest forest fragments in the study area.

Keywords: bees, Euglossini, habitat fragmentation, isolation, dispersal

12:00 Multiple Allee effects in plant regeneration in a fragmented landscape

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The tree Anacardium excelsum was, formerly, widely distributed across the landscape of Guanacaste in Costa Rica, but within this region is now mostly confined to forest fragments that range from a few trees to fragments that are hundreds of hectares in size. We investigated the impact of fragmentation on several stages of regeneration, including pollination, seed production, seed establishment and early seedling growth. We found evidence for multiple Allee effects (disproportionate decline in per capita growth rates at low densities) acting on different regeneration stages, with fragment size having both negative and positive effects at these different life history stages. Furthermore, the vulnerability of later regeneration stages may depend upon impacts at earlier stages, thus Allee effects may be exacerbated or alleviated depending on earlier events. These processes appear to be mediated by fragment size. Consequently, predicting the impact of fragmentation on regeneration of forest trees is likely to be complex and not easily generalisable. Differential and non-independent responses among several reproductive stages necessitate a more careful consideration of Allee effects in the context of fragmentation and life-stage interactions.

Keywords: Allee effect; Anacardium; fragmentation; pollination; regeneration

23 Part I Biosphere reserves: a sound strategy for the conservation of biological diversity and development in the American tropics?

THURSDAY JULY 19
Room 1: Teatro José Ruben Romero
Bulding: Teatro José Ruben Romero (Auditorium)

Organized by:
- Sergio Guevara Sada, Departamento de Ecología Funcional, Instituto de Ecología, A.C., Xalapa, Veracruz, México

The first biosphere reserves were created at the beginning of the 1970s and today there are more than 500 of them worldwide. This impressive number of reserves is distributed throughout practically all of the countries in the world and covers a good part of the diversity found in the planet's tropical ecosystems. This means that the biosphere reserves of the MaB Program are the most successful attempt ever made to conserve biodiversity in the wet and dry tropics and subtropics. These reserves, their coverage and the search for sustainable development that is carried out within them represent a promising strategy for conservation and tropical development to work in concert. However, bringing this harmony about also requires an analysis of the current situation in the reserves, serious reflection on both their strengths and their weaknesses. This information is necessary to the aim of planning new reserves in light of the prevailing environmental conditions, and to that of making the required modifications in existing reserves to ensure their continued efficiency.
The question that drives this symposium is, "Are the biosphere reserves our best option for conserving biological diversity and for promoting sustainable development in tropical ecosystems?" The objective of the symposium is to evaluate the results obtained in the biosphere reserves to date, and to look ahead to what the future holds for them under global climate change and the expansion of the land destined for agricultural, pasture and urban use.

10:00 Hotspots and conservation: a misleading paradigm

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The idea that by concentrating conservation of biodiversity, understood as no-use or low-use, in a few selected "hotspots" of high-diversity and high-risk has become a favorite one of some major NGOs and funding agencies. In this presentation I provide evidence that biodiversity patterns are scale-dependent and therefore cannot be understood in terms of a spots of high-diversity defined at a global scale. Moreover, since the functions of biodiversity are spatially extended and dynamic in time, what it is really needed is to develop strategies to deal with a widespread view of biodiversity pattern and function, at different scales. Biosphere reserves are a step in the right direction.

Keywords: Hotspots, biodiversity, Conservation, biosphere reserves, scale-dependence

10:20 Biosphere Futures: UNESCO Biosphere Reserves for sustainable development program on man and the biosphere (MAB)

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I will discuss five main themes, as identified at the 19th session of the MAB-ICC in October 2006:

- What are the experiences and tools developed in the Millennium Ecosystem Assessment that could improve management and governance of Biosphere Reserves and increase the capacity to deal with change and uncertainty? How can BR contribute to improve management and valuation of ecosystem services?
- What are the implications for each of the biosphere reserve zones contributing to conservation and development taking into consideration constraints and opportunities inherent of each zone?
- How BRs can be a learning platform for interactions between science, policy and practice in order to generate usable knowledge for sustainable development?
- How can the MAB + BR Regional Networks be strengthened to become the main drivers of MAB and BR agendas?
- What are the policy and political initiatives needed to articulate and confirm the niche of BRs as learning laboratories for sustainable development?

The expected discussions will eventually guide the 'Madrid Action Plan (2008–2012), which will define the role of biosphere reserves in the 21st century both for the preservation of natural and cultural resources as well as supporting sustainable development that understands that humans are an integral part of the biosphere.

Keywords: Sustainable development, ecosystem systems, biosphere reserve

10:40 Is it worth protecting Biosphere reserves?

Rene Gonzalez-Montagut
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The conservation of the Biosphere Reserves requires both; long term work and financing. In the last ten years a select group of Biosphere Reserves has received private as well as public financial resources. Private resources are guaranteed in the long term and therefore the development of management plans based on medium term results is possible. The monitoring of these results shows advances in high-priority activities of the Biosphere Reserves. In particular the impact of the support to the reserves seems to be related with a slower rate of transformation of the natural habitat, in comparison with the reserve surroundings. Also the impact is shown on positive population tendencies of keystone species, as well as in the increment of both areas under sustainable

management and the number of people involved in these efforts. These are preliminary results. Mexico has exceptional characteristics to monitor the state of health of its Biosphere Reserves in the long term. Investment in this monitoring is without a doubt a necessary condition to enhance the financing and to assure the future of our Biosphere Reserves.

Keywords: sustainable management, financing, Monitoring, long term, Biosphere Reserves

11:20 Biosphere reserves: a mexican project for conservation and development

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The activities performed in Mexico's biosphere reserves are aimed at implementing International strategies and agreements. The context in which the reserves have been developing has been changed gradually by the different conventions, now acknowledging as essential elements the close relationship between conservation of biological diversity and the needs for development of local communities, all within a framework of international cooperation. Mexico's experience has been a significant contribution to the development of the concept, as it has demonstrated the importance of establishing long-term research programs that are sensitive to the conditions of local inhabitants, always involved in the task of conservation. The most common lines of research extend to ecotourism, monitoring, community participation and socioeconomic aspects. Biosphere reserves are fundamental in cooperation and the implementation of other international agreements, such as the Convention on Biological Diversity, the Ramsar Convention on Wetlands and the World Heritage Convention. However, for México, the key role of the reserves is to demonstrate that ecosystems and their biodiversity can be protected from a wider perspective.

Keywords: long term research, monitoring community, convention on Biological Diversity, Ramsar Convention, World Heritage

11:40 Protected areas, cauldron of sustainable development

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Protected areas, among them Biosphere Reserves, have been one of the most useful and commonly used instruments for preserving biodiversity. Nevertheless, findings of the Millenium Assessment, environmental and socioeconomic impact of climate change, and increasing poverty in many biodiverse countries make it necessary to find other options to guarantee conservation of ecosystems as well as their biodiversity and processes. In this paper I would like to present the experience of community projects in the coastal area of Veracruz in the Gulf of Mexico. In these projects, conservation is being

addressed at the landscape level and seek to motivate locals towards a society sensitive to nature and the needs to protect coastal and landscape processes. They have included work with local people fishermen, cattleranchers, women- as well as with local and state government agencies. The projects are based in the coastal protected area of CICOLMA belonging to the Institute of Ecologia A.C. The reserve works as a site from where environmental problems are addressed, research is generated, and community participation is promoted. Emphasis is on hands on experiences and interaction between society, government and researchers. The objective is to generate a matrix around the protected areas, where interacting ecosystems are managed in a sustainable way by the community. Today we have sustainable community projects such as ecoturism, a native plant nursery, a community botanical garden, and plant artcrafts. We have also developed conservation programs for the migration of the blue crab, among others. Participating community groups have become local leaders promoting environmental education in their own communities. On the other hand, the projects have also generated antagonism in certain groups, mainly cattle ranchers. Environmental law contemplates instruments but procedures are little developed and seldom applied.

Keywords: community participation, sustainable management, ecoturism, environmental education, Gulf of Mexico

12:00 Tropical forest research in Biosphere Reserves in Mexico: perspectives, challenges, and opportunities

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The most urgent challenge in tropical forest research is exploring the interface between ecology and the socioeconomic forces that cause ecosystem transformation and degradation. World-wide, deforestation and land use change causes the rapid loss of tropical forests with dramatic, negative consequences for biodiversity, ecosystem function and services. Biosphere Reserves play a major role in protecting tropical forests, but alone do not ensure forest preservation. There is an urgent need to generate scientific knowledge and tropical forest management techniques that promote human well being in a context of ecological sustainability. The next step is the adoption of an interdisciplinary research approach, where the natural and social sciences join in an effort to provide the basis for sustainable forest management. Studies being conducted at Los Tuxtlas, Chamela-Cuixmala, Calakmul and Montes Azules Biosphere Reserves in Mexico will be used to show how interdisciplinary research teams can develop scientific basis for sustainable tropical forest management.

Keywords: Rainforest, Mexico, Ecosystem Management, Sustainable Development, Biosphere Reserves

#24 Linking Tropical Biology with Human Dimensions in the West Indies and Beyond

THURSDAY JULY 19
Room 1: Teatro José Ruben Romero
Bulding: Teatro José Ruben Romero (Auditorium)

Organized by:

- Brian M. Boom, Director, Caribbean Biodiversity Program. The New York Botanical Garden
- Jesús Danilo Chinea Rivera**,** Departamento de Biología. Universidad de Puerto Rico, Mayagüez

This symposium will explore ways that biological research initiatives in the Caribbean, and one in Amazonia, are incorporating human dimensions into their approaches and objectives. Following a broad overview of the topic, four case studies from the Greater Antilles and one from Brazil will be presented that illustrate the integration of social and natural sciences to different degrees and in various ways: (1) the past, present, and future of the Long-Term Ecological Research (LTER) project in Puerto Rico, (2) the land-use history in the Luquillo Experimental Forest, Puerto Rico, (3) the case of a GEF project on protection of biodiversity and sustainable development in Cuba, (4) an example of research on predicting the influence of climate change on biodiversity in the Greater Antilles, and (5) a study on the interactions of ecological systems and indigenous people in Brazil. Lessons learned from these examples will be valuable to other biological research initiatives throughout the Caribbean and beyond, especially those that aspire to achieve genuine biodiversity conservation and sustainable development successes that are compatible both with ecosystems and with the people who live in and from them.

14:00 The Caribbean Islands: a microcosm for biodiversity research that benefits human welfare

Michael Leonard Smith and **Larry Gorenflo**
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Biodiversity research can be effectively coupled with human development because biological and cultural diversity are distributed in a highly concordant way. The biodiversity hotspots provide an example at the global scale. Delineated on the basis of vascular plant endemism and threat, they house 50% of the world's plants and 42% of its terrestrial vertebrates as endemics. Although they cover only 15.7 percent of the world's land surface, they are home to one-third of humanity and about half of the 6,900 languages still spoken. Because the hotspots are delineated in part on the basis of altered plant cover, the people within them are often very poor and subject to civil strife.

For instance, in 2000 infant mortality rates were worse than the global average in 31 of the 34 hotspots. The Caribbean island arc is a microcosm of the same issues on a regional scale. Its complex mosaic of marine, freshwater and terrestrial habitats has provided thousands of isolated sites for the diversification of species, making it one of the world's great reservoirs of unique species. Geographic factors that led to high biological diversity are associated with high political and cultural richness. The islands comprise the world's greatest concentration of small countries representing the full range of the worlds political systems. Biological research was long carried out by explorers from outside the region for the benefit of colonial interests on the continents, often leaving island societies bereft not only of their original resources, but also of the information that is needed to conserve what remains. Cases presented in this symposium aim to reverse that trend, in part by focusing research and conservation activities where they will provide greatest benefits to the poor.

Keywords: biodiversity conservation; human welfare; colonialism

14:20 Integrating the human factor into the Luquillo Long-Term Ecological Research Program: past, present, and future

Jess K. Zimmerman [1], Katie Hein [2], Todd A. Crowl[2], Tischa Munoz Erickson[3], Armando Gonzalez Caban[4], Alan C. Covich[5], Frederick N. Scatena[6], Charles A. S. Hall[7] and **John B. Loomis [8]**
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Research in the US Long-Term Ecological Research (LTER) Network initially began with a focus on ecosystem processes at pristine sites. Many sites are now expanding the conceptual scope of their research to include aspects of social science into what is termed a Social Ecological System (SES). We review the history and progress of the study of the human dimension in the Luquillo LTER in Puerto Rico. Recognition that many of our study areas were not primary forest stimulated a deeper interest in land use history and changes of forest cover in Puerto Rico in relation to historical changes in the human population and its socioeconomic characteristics. Aquatic systems were studied for the impacts of dams and water withdrawals on migratory stream organisms. In these studies, humans were regarded as drivers of ecological change and not an integrated component of a larger SES. An ongoing Biocomplexity project at Luquillo embraces the SES concept and is investigating the interactions between river and road networks to determine how the geophysical, ecological, and human characteristics of the nodes of the two networks influence such things as biotic integrity of aquatic communities and recreational use. Our LTER research is beginning to include metropolitan San Juan and an urban stream, the Río Piedras. Using the SES approach, we will focus on changes in

human resource use, perceptions of the environment, and land use, as well as regional climate change, relative to changes in water quality and quantity, as well as the biodiversity of terrestrial and aquatic communities. Study of the feedbacks of the ecological component of the SES on the human component will focus on ecosystem services provided by terrestrial and aquatic ecosystems. We will integrate these factors into a framework based on individual-based modeling that will be useful for urban planners as well as scientists.

Keywords: Long-Term Ecological Research, Social Ecological System, river and road networks, ecosystem services

14:40 Human dimension of land-use history in the Luquillo Experimental Forest, Puerto Rico

Diana García Montiel
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Significant human activity has always impacted the natural environment of the Puerto Rican Island. The history of land-use in the Luquillo Experimental Forest clearly documents how since the arrival of Spanish the major drivers of deforestation have been tightly linked to social, cultural and economical factors. Prior to 1800s a land distribution program started by the Spanish crown marked the start of extensive agriculture, mainly for coffee plantations. The need for subsistence agriculture also impacted many areas of relatively accessible forest areas. However, major changes in socio-economical drivers later during 1900s allowed the reversion of this pattern through forest management by the USDA Forest Service. This example from the LEF clearly documents how the human component has historically determined the patterns of deforestation and/or reforestation in the island of Puerto Rico.

Keywords: Land-use, Ecological history, Human dimension, Luquillo Experimental Forest, Puerto Rico

15:20 Predicting the influence of climate change on biodiversity in the Greater Antilles: an example using Anolis lizards

Jason Knouft[1], and **Trisha Consiglio[2]**
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Global climate change is a commonly accepted phenomenon that will potentially have dramatic effects on the Earth's biodiversity and ecosystem function. Although the environmental changes associated with this climatic variability have been predicted in detail, the potential effects of these climatic changes on species' distributions are not well understood. Over long periods of time, species have been able to respond to gradual climatic changes, but the current rapid changes in these conditions and their impact on species' distributions is of significant concern. To assess the potential effects of climate

change on insular species, we assembled a dataset consisting of 4,188 individual localities from 60 species of Caribbean Anolis lizards. Using these locality data, geographic information system (GIS) environmental layers representing current and future climate predictions, and the Maxent ecological niche modeling algorithm, we predicted the potential shifts in species' distributions for Anolis species on the major islands of the Greater Antilles. Results suggest that some species will experience dramatic reductions in suitable habitat. However, other species may experience increases in the amount of suitable habitat. In almost all species, some portion of current population localities will no longer reside in areas of suitable habitat. Multivariate estimates of niche breadth and niche marginality were calculated to assess whether these measures could be used as predictors of species' susceptibility to the impacts of climate change. Results from these analyses suggest that species on Cuba, Jamaica, and Puerto Rico with specialized niches will be the most impacted by changes in climate. Results from this study will be discussed in the broader context of the potential impacts of climate change on species' distributions and the relationship between habitat heterogeneity and patterns of biodiversity on islands.

Keywords: climate change, Anolis lizards, Greater Antilles, biodiversity

15:40 Multi-Scale Interactions Between Ecological Systems and Indigenous Peoples: Biocomplexity, Interdisciplinarity and Practical Approaches

Jose Vieira Fragoso[1], Joel Strong[1], Kirsten M. Silvius [2], Jane M. Read [3], James B. Gibbs [4], Jerome Chave[5], L.F.B de Oliviera[6] and **Robert P. Miller [7]**
[1]University of Hawaii
[2]Gordon and Betty Moore Foundation
[3]Syracuse University
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[5]Centre National de la Recherche Scientifique
[6]National Museum of Brasil
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The 300 to 500 million indigenous peoples of the world represent 5000 distinct ethnic groups and occupy 20% of the world's land surface. In the Amazon basin of Brazil, for example, about 21% of the area consists of indigenous territories (approximately1.1 million km²). The Amazon basin is probably the most species rich area on earth; thus, indigenous lands here support a significant amount of the world's biodiversity. What role will these lands play in the conservation of biodiversity? How will changes in indigenous culture influence biodiversity? How will changes in biodiversity influence indigenous culture? Our interdisciplinary team of biologists, anthropologists, geographers, modelers, education specialists and indigenous peoples is working in the northern Amazon region to address these questions. In this presentation we focus on the lessons learned from working as an interdisciplinary team, consider some unexpected surprises, highlight problems encountered and their resolution, and suggest that the implementation of a project like this one is in itself an appropriate subject of inquiry for furthering biocomplexity research.

Keywords: Biocomplexity, interdisciplinarity, coupled human-natural systems, biodiversity, Amazon

20 Part II Seed dispersal and seed predation in Neotropical palms

THURSDAY JULY 19
Room 2: Conservatorio de las Rosas (Auditorium)
Building: Conservatorio de las Rosas

Organizer by:

- Patrick A. Jansen, Community and Conservation Ecology University of Groningen, the Netherlands
- Kirsten M. Silvius, Gordon and Betty Moore Foundation, San Francisco

14:00 Seed predation and the Arecaceae: a valid model for tropical systems?

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What can be learned from single-taxon studies of seed predation, and how suitable is the Arecaceae as a model for seed predation in general? In order to be an appropriate model for the effects of seed predation on tropical forest structure and dynamics, the Arecaceae should be ecologically representative of plant taxa in general. This study examines what is known about (1) how palm taxa respond to environmental variation compared to arborescent species in general, using studies from Central and South America and (2) population dynamics of palms and their associated guilds of seed predators. In the studies examined, patterns of variation in the composition of palm species is similar to those of arborescent taxa in general, suggesting that palms and other taxa respond similarly to community-organizing forces. Physiological and morphological constraints imposed by Arecaceae phylogeny on palm reproduction offer unique opportunities for detailed quantification of plant population dynamics, however they impose considerable limitations to the applicability of long-term studies of palm seed predation and dispersal.

Keywords: seed predation, seed dispersal, palms

14:20 Seed dispersal and predation in two Atlantic Forest palms with different responses to habitat loss

Alexandra dos Santos Pires[1], Cecilia Siliansky de Andreazzi[2], Clarissa Scofield Pimenta[2], Fernando Antonio dos Santos Fernandez[2] and **Mauro Galetti [2]**
[1]Departamento de Ciencias Ambientais, Universidade Federal Rural do Rio de Janeiro
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Fragmentation impacts biodiversity through several mechanisms, including the disruption of plant-animal interactions. We investigated the processes of seed dispersal and predation in two palms dispersed by scatterhoarding rodents but with distinct responses to fragmentation: *Astrocaryum aculeatissimum*, which is negatively affected, and *Attalea humilis*, which increase their abundance in small remnants. *Attalea* has more pulp, a

harder endocarp and 1-3 seeds per fruit, while *Astrocaryum* has thinner endocarp and only one seed per fruit. We compared seed predation beneath parents and seed dispersal rates among large (2400 and 3500ha) and small (19, 26 and 57ha) Atlantic Forest fragments in southeastern Brazil. The number of endocarps remaining beneath palms was significantly higher in small fragments, both for *Astrocaryum* ($U=98$, $p<0.01$) and *Attalea* ($U=168$, $p<0.01$), indicating low seed removal in these remnants. For *Attalea*, this result was also due to increased fruit production in small areas ($U=115.5$, $p<0.01$). Predation rates by rodents beneath palms were low (below 20%) in most cases for both palms. Beetle predation seemed to be more important, as rates were high (always above 60%). For *Astrocaryum* beetle predation was higher in small remnants ($U=512.5$, $p<0.05$) whereas for *Attalea* predation rates tended to be higher at the larger ones ($U=138$, $p=0.08$). For both palms, the number of dispersed seeds was lower in smaller fragments (*Astrocaryum*: $U=1619.5$, $p<0.01$; *Attalea*: $U=1258.5$, $p<0.01$), where viable populations of dispersers (such as *Dasyprocta* spp.) probably cannot be maintained in long term. In synthesis, in small fragments *Astrocaryum* is strongly affected by the intense predation pressure from beetles combined with the loss of its dispersers, whereas *Attalea*, even with reduced dispersal rates as well, is more resilient because it suffers less predation by beetles and because its higher productivity allows high local recruitment. Support: FAPESP, CNPq, CYTED, Idea Wild.

Keywords: fragmentation, palms, seed dispersal, seed predation, Atlantic Forest

Hunting indirectly alters the abundances of insect seed predators

14:40

S. Joseph Wright[1], Dumas Galvez and **Patrick A. Jansen[2]**
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Hunters are removing game species from most tropical forests, giving rise to the pantropical bush meat crisis. Game species interact with plants as seed dispersal agents and seed predators, and through these interactions hunting also affects plants. Game species also interact with insects, and we will explore how hunter-game species interactions affect insect seed predators and their palm hosts. Seeds of the palm, *Attalea butyraceae*, are eaten and killed by larvae of the bruchid beetle, *Speciomerus giganteus*. The female bruchid is only able to lay eggs on the stony endocarp after the tough exocarp has been removed. The hard, white eggs are nearly 2 mm long and are easily counted. A single larva develops inside a seed, and the emerging adults leave large circular exit holes. These traits make it possible to manipulate seed availability to bruchids and to determine how many eggs are produced and how many adults recruit to the bruchid population. We compare bruchid population dynamics at protected and hunted sites. The agouti, *Dasyprocta punctata*, is both a prized game species and a voracious predator of *Attalea* seeds and the bruchid larvae they contain. An order of magnitude more adults recruit to the bruchid population at hunted sites, where predation by agoutis on bruchid larvae is greatly reduced. The phenology of oviposition differs with eggs produced year-round at hunted sites and just during the six months of peak seed production at protected sites. Nonetheless, the number of eggs produced is only twice as large at hunted sites as at protected sites. This suggests compensatory mortality among adult bruchids at hunted sites. Bruchids only kill 70% of the available seeds at hunted

sites, and many more seeds survive to produce seedlings at hunted sites than at protected sites. Similar hunter-gameplant-insect interactions are to be expected elsewhere.

Keywords: bruchid beetle, hunting, seed predation, larval predation, beetle recruitment

15:20 Hunting relieves recruitment limitation in a Neotropical palm

Patrick A. Jansen[1], Pieter Van Eijk[1], S. Joseph Wright [2] and **Helene Muller-Landau[2]**
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Recruitment limitation contributes to the coexistence of many tree species in tropical forest. We studied how various components of recruitment limitation are affected by hunting, which alters the mammal fauna, changing the abundances of seed dispersers and natural enemies. We studied the palm *Astrocaryum standleyanum*, the agoutis that disperse palm seeds through scatter-hoarding, and various mammals and insects that depredate the seeds, in Central Panama. We selected 60 individuals across 12 plots with contrasting levels of hunting and palm abundance, and compared rates of pre- and post dispersal seed predation, seed removal, seed dispersal, seed survival, seedling establishment, and seedling survival. We found that two components of recruitment limitation, source limitation and dispersal limitation, were stronger under hunting. But, the third component of recruitment limitation, establishment limitation, was dramatically weaker under hunting. The net effect of hunting was to relieve intense recruitment limitation. Our results suggest that hunting can indirectly affect mechanisms of species coexistence. This effect may partially explain why palms attain dominance in disturbed forests, which usually have high levels of hunting, at the cost of other tree species and hence biodiversity.

Keywords: *Astrocaryum standleyanum*, Panama, seed dispersal, seed predation, seedling recruitment

15:40 Impact of vertebrate defaunation on seed predation and dispersal of palms: implications for rain forest conservation

Eduardo Mendoza and **D Camila onatti**
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Palms are an emblematic component of tropical forests that exemplifies the complex network of trophic interactions occurring in these ecosystems. A diverse array of vertebrates preys upon palm seeds, impacting the seed/seedling transition. At the same time, a large proportion of palm species rely on vertebrates to disperse their seeds and escape from the attack of other vertebrates and insects. Both ensembles of animals (predators/dispersers) include a common set of species, predominantly medium and large-bodied mammals and birds. Defaunation is strongly decimating populations of medium and large mammals, a situation contrasting with that observed in populations of

small rodents and birds, which seem to be coping better with anthropogenic perturbation. This situation opens the possibility to find divergent effects of defaunation on palm recruitment brought about by the simultaneous breakdown of predation and dispersal interactions. This study is aimed at: i) providing an overview of the levels of palm seed predation by vertebrates and palm dependence on vertebrate dispersal as inferred from the literature, ii) presenting case studies from rain forests sites in Brazil and Southeast Mexico illustrating the mechanisms that may lead to palm decline in the absence of their dispersers (recruitment limitation) or palm escape in the absence of their seed predators (differential size related predation), iii) presenting a conceptual framework to guide the study of the factors that need to be taken into account to evaluate the overall impact of vertebrate predator/dispersal defaunation on palm performance. Our study indicates that there is a spectrum of responses to defaunation among palms and that these responses are scale dependent. However, whether palm populations respond positively or negatively to defaunation there is a strong potential for rain forest functioning to be affected as a consequence of the disruption of vertebrate-palm interactions.

Keywords: Defaunation, palms, seed dispersal, seed predation, rain forest conservation

16:00 A plague of palms: why large-seeded *Attalea* form monodominant stands in anthropogenic landscapes

Jose Manuel Vieira Fragoso [1] and **Kirsten M. Silvius**[2]
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Researchers have long commented on the predilection of *Attalea* palms to form large monodominant stands on pasture and farmland. A number of hypotheses have been proposed to explain this phenomenon, including fire resistance and removal of potential competitors. We compared seed mortality around adult trees in pasture and old growth forest and found significantly higher survivorship in pasture. Bruchid beetles and fungi were the only mortality agents in pasture, while these plus white-lipped peccaries and rodents added significantly to mortality in forest. We found no difference in beetle generated mortality between the two vegetation types. However, in pasture survivorship was higher due to a lack of seed depredation by white-lipped peccaries and rodents. Mortality by beetles in forest may be higher than measured, as white-lipped peccaries open seeds to eat beetle larvae. Early stage seed survivorship patterns sets the regeneration trajectory and in pasture this contributes to the formation of high-density monodominant stands of *Attalea* palms.

Keywords: *Attalea*, Bruchid beetles, recruitment limitation, Janzen-Connell, pasture succession

21 Part II Functional Ecology of Tropical Plant Communities

THURSDAY JULY 19
Room 3: Cervantes Saavedra (Second Floor)
Building: Colegio Primitivo de San Nicolás de Hidalgo

Organized by:

- Horacio Paz, Centro de Investigaciones en Ecosistemas, Universidad Nacional Autónoma de México
- Lourens Poorter, Forest Ecology and Forest Management Group, Centre for Ecosystem Studies, Wageningen University
- Louis Santiago, Department of Botany and Plant Sciences, University of California, Riverside
- Kaoru Kitajima, Department of Botany, University of Florida

Drought tolerance strategies of tropical forest plants from contrasting habitats

14:00

Louis Santiago
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Drought tolerance and avoidance represent two main ways in which plants deal with water limitation. Loss of leaves through dry season deciduous phenology is a major mechanism of drought avoidance in tropical trees. Tropical forests vary along a gradient from seasonally dry forests with a high proportion of canopy species that lose their leaves during the dry season, to continuously wet forests dominated by evergreen canopy species. Data from a precipitation gradient in Panama demonstrates that deciduous species minimize water loss and respiration costs during seasonal drought, but have relatively high photosynthetic rates, allowing them to maintain high rates of carbon gain when water is available. In contrast, evergreen species have lower photosynthetic rates, but have a potentially longer photosynthetic season. Evergreen species also appear to reduce demand on soil nutrients required to replace leaves. Although seasonally dry tropical forests are appreciated for their preponderance of dry season deciduous species, which represent a drought avoidance strategy, these forests often have an evergreen component which represents the drought tolerant strategy. Data from an extremely dry forest in Mexico suggests that there is a marked divergence in strategies in which species show strong deciduous or evergreen phenology under extreme water stress. In subtropical arid ecosystems of southern California, these tradeoffs are yet more pronounced, with thick-leaved, evergreen chaparral shrubs and cacti representing extreme drought tolerance strategies, and drought deciduous coastal sage scrub and desert annuals representing extreme drought avoider strategies.

Keywords: drought tolerance, phenology, California, Mexico, Panama

14:20 Drought tolerance and water relations: regional and global perspectives

Amy Zanne[1], David Ackerly[2], David Coomes[3] and **Ian Wright[4]**
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Moisture availability is believed to exert strong selective pressure on plant traits, especially with respect to wood anatomy and hydraulics. We have been investigating coordination of wood anatomical and hydraulic traits with leaf traits at regional scales in Australia and California and global scales. These relationships have also been investigated along gradients in precipitation. We predicted that species with higher wood density would have lower hydraulic conductivity and be found in areas with lower precipitation. Additionally, we expected that hydraulic traits would be better coordinated with traits related to amount of leaf area deployed per sapwood area (LASA) than to leaf size. At the regional-scale in Australia, we have measured wood density, vessel anatomy, leaf size, LASA, maximum plant height, and hydraulic conductivity for a total of 32 tree and shrub species at sites contrasting in average annual rainfall (387 vs. 1220 mm). Additionally, we have assembled a global database (approximately 4000 species) of wood density, vessel size and vessel density for trees and shrubs. In both the regional and global study, we have found that wood density is relatively uncoupled from hydraulic traits. Instead, vessel size and vessel density are scaling isometrically such that total vessel lumen is being maintained. Furthermore, hydraulic conductivity and vessel anatomy are strongly related to the amount of leaf area deployed (LASA) and the maximum height that plants attain. Precipitation was still a strong predictor of hydraulic, wood density, and leaf traits. The higher rainfall sites had higher hydraulic conductivity, LASA, but lower wood density. These results suggest that wood density is more strongly related to functions other than hydraulics (e.g., mechanical support or storage) and that hydraulic conductivity appears to be a strong determinant of the amount of leaf area carried by a plant.

Keywords: Australia, hydraulic conductivity, precipitation, wood density, vessel anatomy

14:40 Plant hydraulic strategies in subtropical shrub communities

Radika Bhaskar[1], David Ackerly[1] and **Alfonso Valiente-Banuet[2]**
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Under conditions of drought, the ability to regulate water use is of critical importance to plant performance. To prevent stomatal shut-down and hydraulic failure, plants must balance water supply from the roots with transpirational water loss through the leaf. Thus, both soil water deficit (soil drought) and evaporative demand (atmospheric drought) present distinct challenges for plants. Comparing communities with contrasting precipitation patterns provides an opportunity to examine how timing of soil versus

atmospheric drought influences plant water use and consequently carbon gain. In California, chaparral shrublands experience hot, dry summers and cool, wet winters, characteristic of Mediterranean environments; thus soil and atmospheric drought coincide. In central Mexico, subtropical shrub communities are morphologically and taxonomically similar to California chaparral, yet climatically distinct: a winter drought is followed by summer monsoonal rains. Sites in Santa Barbara, California, and Tehuacan, Mexico, were matched for mean annual temperature, precipitation, and drought duration. Two suites of traits were measured, one related to hydraulic function (e.g. conductivity, minimum seasonal water potential, vulnerability to embolism, wood anatomy), and the other to the leaf economic spectrum (photosynthetic rate, nitrogen concentration, specific leaf area, and carbon isotope composition). Within both communities, species varied widely in hydraulic traits; those with lower leaf-areabased whole plant hydraulic conductance (Kwp) experienced more negative minimum seasonal water potentials. However, species in California, where atmospheric drought was higher, had significantly higher rates of Kwp relative to species in Mexico. The shift observed between sites in Kwp demonstrates how soil and atmospheric drought may have opposing influences on hydraulic architecture. On functional grounds we expected a link between photosynthetic and hydraulic capacity. However, in contrast with results from more mesic systems, Kwp and maximum assimilation were poorly correlated, suggesting photosynthetic and hydraulic strategies may be independent in subtropical arid communities with strong seasonality of rainfall.

Keywords: hydraulic, soil drought, conductance

15:20 Divergence of adaptive traits to wet vs. dry microhabitats in a tropical dry forest

Horacio Paz and **Fernando Pineda-Garcia**
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In tropical dry forests, temporal and spatial variation in water availability is proposed as the dominant factor affecting species life history and distribution. However, the diversity of water use strategies and the trade-offs involved are still poorly known for this community. For seedlings, we analyzed the patterns of morphological and physiological divergences between a group of 10 congeneric pairs, where one species is specialized to dry habitats and the other to wet habitats in the same community. We predicted that compared to wet specialists, dry specialists will increase surface of water absorption in relation to water loss, water use efficiency, stem capacitance, root depth, stem density, and will exhibit lower vulnerability to embolisms, but at the cost of lower photosynthetic and growth rates. We found that as a general strategy, dry species decreased leaf area ratio, allocated more biomass to fat but not fine roots, suggesting that dry specialists reduced water loss area and did not increase water absorption capacity but probably carbohydrate reserves. Strikingly, most of analyzed traits did not diverge between wet and dry habitats in a general direction as predicted, indicating an important diversity of ways of adaptation to dry habitats. Variation among drought- functional traits seems to be organized along two axes of variation, the leaf life-length, and a trade-off between stem capacitance and vulnerability to embolisms. Also, dry specialists were less plastic adjusting their morphology to the soil water treatment. This differentiation suggests a soil

water exploiting strategy for the wet specialists and a more resource conservative strategy for the dry specialists.

Keywords: drought tolerance, seedling morphology, seedling physiology, trade-offs, tropical tree seedlings

15:40 Seedling traits determine drought survival and distribution of Bolivian tropical tree species

Lars Markesteijn and **Lourens Poorter**
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Water availability is the most important factor determining tree species distribution and differentiation in the tropics, still underlying mechanisms are still not clear. In a tropical dry deciduous and a moist semi-deciduous forest we excavated first year seedlings of 62 tree species at the onset of the dry season. We quantified the variation in morphological root traits and biomass allocation of the seedlings from both forests and assessed functional grouping of species related to drought tolerance on the bases of among trait associations. In a separate study we quantified species ability to survive drought under standardized experimental conditions in order to evaluate how seedling traits affect drought survival, and how drought survival in turn determines species distribution along the rainfall gradient. Seedling traits of both studies were compared in order to validate whether patterns found under standardized conditions are in line with the actual situation as found in the forest.

Keywords: Bolivia, drought tolerance, morphology, survival

16:00 Staying and leaving: functional traits along gradients of tropical dry forest succession

Edwin Lebrija-Trejos[1], Erik Peters[1], Eduardo A. Perez-Garcia [2], Jorge A. Meave[2], Frans Bongers[3] and **Horacio Paz[4]**
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Tropical forest succession involves vertical and horizontal changes in light availability. Models of succession and species performance have been closely related to these (steep) gradients, with species often arbitrarily assigned to predefined functional groups based on their light requirements for regeneration and adult stages (maximum height). In dry forests, changes in light availability during succession are expected to be reduced due to shorter canopy stature and more patchy development. Hence, other factors such as water availability and day time temperature are expected to increase their role in

determining species performance and, consequently, community assemblage changes. To evaluate the importance of these latter factors, we analyzed the relationships between species traits, community dynamics and environmental factors along secondary succession plots in a tropical dry forest of southern Mexico. PAR, soil and air temperature, and water vapor deficits decreased significantly with community development, no clear pattern was observed for soil surface water potential. Species recruitment, survival and abundances varied along succession, with traits related to transpiration and heat dissipation clearly separating early from late successional species. More in-depth studies of tropical dry secondary and mature forest species traits and trade-offs related to temperature and water stress are needed to properly characterize functional groups, understand niche differentiation and model secondary succession in theses systems.

Keywords: Functional Traits, Pioneers, Drought Stress, Secondary Succession, Tropical Dry Forest

23 Part II Biosphere reserves: a sound strategy for the conservation of biological diversity and development in the American tropics?

THURSDAY JULY 19
Room 5: Aula Mater (First Floor)
Building:Colegio Primitivo de San Nicolás de Hidalgo

Organized by:
- Sergio Guevara Sada, Departamento de Ecología Funcional, Instituto de Ecología, A.C., Xalapa, Veracruz, México

14:00 Restoration ecology as a tool for conservation in Biosphere reserves

Fabiola Lopez Barrera and **Sergio Guevara Sada**
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Standard goals of ecological restoration include the rehabilitation and creation of ecosystems, as well as the restoration of important ecosystem services. All these activities, coupled with networks of natural protected areas established within a landscape, provide a functional framework for conserve biodiversity and promote the sustainable use of natural resources at the landscape level. This talk will elaborate on the connections between these and other concepts such ecological networks and forest landscape restoration in the formulation of new strategies for conservation in the tropics. By providing several examples, we highlight how restoration ecology is an increasingly important tool for creating a coherent system of habitats adjacent to natural protected areas that both provide landscape connectivity and enhance human well-being (e.g. improving the supply of goods and ecological services) in deforested or degraded forest landscapes. Biosphere reserves combine core protected areas where extraction is not permitted with buffer zones where the sustainable use of natural resources is fostered by local communities. This design promotes greater stability in patterns of land-use and thus should enhance the capacity to conduct long-term restoration projects. However, such projects should need to be interdisciplinary and incorporate larger-scale (both temporal and special) approaches in order to maximize success.

Keywords: ecological networks, landscape, restoration, connectivity, buffer zones

14:20 Urban Biosphere Reserve: an alternative for the life quality in the cities

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Cities are subjected to a strong pressure of populational growth and territorial expansion, which both generates large impacts for life quality and for the conservation state of the natural resources; intra-urban and peri-urban.

In a world in which urban population surpass the rural one and where the number of big cities has grown 10 times during the XX th century, the environmental impact of big cities currently represents one of the major concerns of humanity. In large, social exclusion occurs in cities, as well as a great proportion of the contribution that their effects cause in global warming. urban ecology hearten by the Program Mab of UNESCO, - started since the 70`s - to study investigate these serious problems and to foster solutions. Recently, there was a broadening of the concern and the initiatives to take the concept of RB (Biosphere Reserve) to urban areas, first to protect a green perimeter for the cities and lately to intervene directly from the heart of the cities, in order to contribute to the own sustainability, in questions so vital as the flows of matter, energy and information.
The author of this talk has directed the project of RB in urban environment in the city of Florianópolis in Santa Catarina island (Brazil). A case in which the new concept is being investigated, as well as promoting the articulation between the natural resource management in a subtropical environment and urbanistic growth needed for their 300.000 inhabitants. The analysis of this case and its contribution for the future of the Biosphere Reserves, could be relevant to confront the challenges that the urban-rural conflict is generating particularly in Latin America.

Keywords: urban reserve, Brazil, MAB RESERVES, life quality, ursbanistic growth

14:40 Integrating biodiversity conservation, knowledge and sustainable development: The experience of the Mata Atlântica/Brasil's Biosphere Reserve

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The Mata Atlantic Biosphere Reserve - RBMA, has 35 million hectares, being the biggest among the 507 RBs of the MaB/UNESCO System. This reserve was created in 1991 and increased several times, and includes more than 700 areas nucleus. The reservation extends for more than 5 thousand kilometers in the Atlantic coast, covering areas of 15 Brazilian states and being the biggest ecological corridor in the country.
The Mata Atlantic is the threatened Brazilian forest, it has been reduced to 8% of the original area, but it is still one of the richest forests in the world biodiversity.
In these 15 years, RBMA has consolidated its administration system that includes government organs, traditional communities, no-government organizations, scientists and entrepreneurs, becoming the largest articulation net for the knowledge and conservation of biodiversity and for sustainable management of the Mata Atlantic.
The present work synthesizes the main contributions of RBMA to the development of public politics, environmental education, forest conservation projects and sustainable management, which has allowed the construction of a Brazilian model for the application in Biosphere Reserves.

Keywords: Mata Atlantic Biosphere Reserve, Brazil, sustainable management, forest conservation, administration systems.

ORAL PRESENTATIONS

Forest fragmentation and conservation genetics of plants

Room 6: Sala 2 (Second Floor)
Building: Centro Cultural Universitario
Monday July 16

10:00 Comparing natural and anthropogenic fragmentation in the sub-Saharan tree species Acacia mellifera

Ruiz Guajardo M en C Juan Carlos; Otero Arnaiz Dr. Adriana; Schnabel Dr. Andrew; Stone Dr. Graham
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The cosmopolitan genus Acacia (Fabaceae: Mimosoideae) includes more than 1350 species. Most species occupy arid or semi-arid regions and are often the dominant woody components of their communities, forming important ecological interactions with a wide variety of species. Many acacia species are exploited by humans for animal fodder, building materials, medicines, charcoal, pulp, and paper production. Acacia (Senegalia) mellifera is a small tree (10m) widely distributed in sub-Saharan Africa and the southern Arabian Peninsula. Because its wood is termite-resistant, it is often used for building houses and fences, and it is also exploited to produce charcoal and medicines against pneumonia, malaria and syphilis. Using A. mellifera as a case study for a savannah widely exploited tree species, we are currently investigating the genetic structure and historical gene flow occurring between 20 populations distributed across Kenya. Our preliminary analysis using four microsatellite loci shows that 20% of the observed genetic variation among populations can be explained via isolation by distance (Mantel Test R2= 0.20, p <0.05). Although A. mellifera is widely distributed, its distribution is discontinuous, perhaps due to ecological or geographical barriers. We are currently conducting analyses to test whether any differentiation occurs between and within populations that could shed light on these natural fragmentation. Furthermore, to investigate if recent anthropogenic activities are having an effect on A. mellifera*ƒ*?Ts genetic diversity via fragmentation of populations, we will compare historical and recent patterns of gene flow and population structure among the same geographical locations by examining adult trees with recently established trees (<1m).

10:20 Impacts of habitat fragmentation on genetic structure and ecological traits of seven plant species a tropical forest in Mexico

Sandra Cuartas-Hernández; Elsa Figueroa; Pilar Suárez; Bernardo Aguilar; Mariana Chávez Pesqueira; Lilibeth Toledo; Alejandro Montero; Graciela García Guzmán; Juan Núñez-Farfan
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Genetic diversity and structure, and ecological processes may be modified as a consequence of reduction and isolation of plant populations. Many plant species have been studied in different ecosystems, leading to conclusions constrained to a particular species. In this work, we assessed the genetic and ecological effects of habitat fragmentation in seven plant species of different life histories (Dieffenbachia seguine, Aphelandra aurantiaca, Heliconia uxpanapensis, Chamaedorea alternans, Dendropanax arboreous, Nectandra ambigens, Syderoxylon portoricense), including herbs and canopy trees of high structural importance in Los Tuxtlas tropical rain forest, in order to infer the impact of fragmentation on community genetic diversity and ecological processes that are closely linked with its stability. In general, we detected a reduction in genotype number, gene flow rate in distant populations, and a slight increase in genetic divergence. Moreover, reduction in reproductive success, alterations to fruit predation, herbivory, and pollination were observed in different species. From this view, fragmentation has negative effects not only on the genetic structure of each species, but potentially, on the community structure and ecosystem evolution. For this reason, the conservation of genetic diversity of foundation species, in this case, primary trees, N. ambigens and D. arboreous, is relevant to protect the community of future drastic changes. Also, some species did not show any effect of fragmentation on genetic diversity. The results support the view that there is still a chance of maintaining the species' genetic richness, and this should stimulate conservation strategies and efforts in Los Tuxtlas. In addition, the higher survival of samplings of tree species in fragments indicates the potential for regeneration of forest in fragments.

10:40 Potential regeneration of two canopy trees in fragments of the Los Tuxtlas tropical rain forest: effects of seed size, family and plants' natural enemies

Mariana Chávez Pesqueira; Lilibeth Toledo; Juan Núñez-Farfán
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Several environmental factors are known to affect the survival and establishment of plants in natural communities. In tropical rain forests, seed mass is expected to affect the fate of the derived seedlings of shade tolerant species that inhabit the forest understory. Besides, herbivores and plant pathogens may constitute independent or synergistic causes of seedling mortality. Forest fragments are expected to be modified in their physical and biotic conditions in comparison to undisturbed rain forest, potentially affecting plant survival and forest regeneration. In the present study we assessed the fate of seedlings of two structurally important canopy trees at the Los Tuxtlas tropical rain forest, Nectandra ambigens (Lauraceae) Syderoxylon portoricense (Sapotaceae). Seeds from different mothers trees (field progenies) were collected, weighted, germinated in a greenhouse and transplanted to the undisturbed forest and fragments, under a randomized block design for each species. In the field survival, growth, damage by pathogens and herbivores were monitored through time. For both species there were differences among mother trees in seed mass suggesting the presence of genetic variation for this trait. For both species, survival analyses indicated higher survival of seedling in fragments as compared with the undisturbed forest. A similar result was observed for growth variables. However, damage by herbivores and pathogens was higher in the undisturbed forest for N. ambigens and higher in fragments for S. portoricense; damage by pathogens appeared associated to damage by herbivores. The seed mass of the survivor seedlings of N. ambigens was significantly higher than that of dead seedlings in both habitats. However, in S. portoricense this difference was observed only in the undisturbed forest, indicating a contrasting effect of seed size between habitats, and species, in enhancing seedling survival. The results indicate the potential for regeneration of these canopy tree species in fragments and support the hypothesis that fragmentation may affect biotic interactions

11-00 Coffee Break

11:20 Pollen Dispersal Limitation in Fragmented Populations of Tropical Live Oak (Quercus oleoides)

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Effective pollen dispersal distances were estimated using a two generation analysis of microsatellite genotypes in wind pollinated live oaks of Guanacaste Province, Costa Rica. Offspring were sampled from trees throughout the landscape, serving as living pollen traps, and the degree of pollen pool overlap was analyzed by analysis of molecular variance (AMOVA). Pre-existing population genetic structure and variation in flowering time were also included in the analysis to provide an explanation for patterns of gene flow in this region. Physical discontinuity among live oak populations within a matrix of abandoned pasturelands appears to be less important in limiting effective pollen dispersal than microhabitat effects such as flowering time.

11:40 Modeling long-term impacts of selective logging on the genetics and demography of tropical tree species.

Marilyn D. Loveless; Alexandre Sebbenn; Bernd Degen
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In this study, we examine the potential effects of repeated logging cycles on the genetic structure and basal area recovery processes of four Neotropical timber species. We use computer simulations to model logging scenarios representing different cutting cycles and minimum cutting diameters on populations of Bagassa guianensis, Hymenaea courbaril, Manilkara huberi, and Symphonia globulifera. Logging scenarios were applied for six consecutive cutting cycles, and final genetic and demographic descriptors were compared to baseline data from corresponding control scenarios. All species showed a loss of alleles and genotypes and an increased genetic distance after repeated logging. In addition, three of the four species showed an inability to recover their initial basal area under repeated logging. These effects were most pronounced under the most intenstive logging conditions (30-year cycles and 45 cm minimum diameters). Our results suggest that, even under very optimistic conditions for growth and recruitment, current logging practices are not sustainable. In addition, differences in the responses among the four species suggest that logging parameters should take into account the individual life history parameters of timber species in order to improved the likelihood of demographic and genetic
sustainability.

12:00 Long term analysis of habitat fragmentation on the genetic structure of Ceiba aesculifolia

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The reduction of natural populations causes isolation of remnant population, with negative consequences on the genetic structure of plant species. In a four year study, we determined the effect of habitat fragmentation on the genetic structure of progenies of the tropical Bombacaceae tree Ceiba aesculifolia in a Mexican tropical dry forest. We conducted our study in the dry forest of Mexico. We compared trees in populations in two habitat conditions based on density and environmental conditions: (1) disturbed trees populations in disturbed areas consisted of 1 to 2 reproductive individuals per hectare and surrounded by agricultural fields or pastures and (2) undisturbed tree populations consisted of groups of 5 or more reproductive individuals per hectare surrounded by undisturbed mature forest. During four reproductive episodes we estimate the following variables within these populations: outcrossing rate, mean relatedness within and between fruits, genetic structure of pollen pools and external pollen gene flow.

The multilocus outcrossing rate obtained for trees in the different populations for both habitat conditions over the four years indicating that Ceiba aesculifolia presents a predominantly outcrossing breeding system. The analysis of relatedness indicated a full-sib relationship in the progeny between seeds of the same fruit of trees in populations for both habitat conditions over the four years. In contrast, seeds between fruits of trees from undisturbed habitats showed a half-sib or less relatedness than the seeds from disturbed populations. High genetic structure of pollen pools was estimated throughout the four years of the study in populations from both habitat conditions. The analysis of gene flow indicated high levels of external pollen flow in all populations across the four years, both for neighbors of 5 km and 10 kms around core populations. However, for the 10 km neighbor radius, disturbed populations showed greater external pollen flow than undisturbed populations.

Restoration of tropical ecosystems. Part I

Room 7: Miguel Hidalgo (Second Floor)
Building: Colegio Primitivo de San Nicolás de Hidalgo
Monday July 16

10:00 Riparian vegetation diversity, stakeholder use and management practices and restoration activities in the Ayuquila watershed, western Mexico.
Ortiz-Arrona Claudia Irene; Gerritsen Peter R.W.; Martinez Rivera Luis Manuel
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Ecological restoration has an important role to play in sustainable development. It is also recognized that attention is to be given not only to environmental degradation processes, but also to stakeholder strategies affected by restoration activities. This paper addresses restoration activities from such a socio-ecological perspective, based on an on-going action-research project in the Ayuquila watershed in western Mexico. Riparian vegetation in the Ayuquila watershed is highly degraded, especially in the agricultural floodplains. Degradation has occurred, due to agro-industrial farming practices, deforestation and urban pollution. In some cases, original riparian ecosystems have been eliminated completely. Main goal of the action-research project is to characterize both local ecological conditions and stakeholder use and management practices of the riparian zone in order to get socio-ecological scientific knowledge for developing a participatory restoration strategy for the watershed. Sampling of 36 riparian fragments along 90-km of the Ayuquila river was realized and a total of 118 woody plant species recorded. Reference sites were identified based on ecological characteristics and the degree of anthropogenic disturbances. Interviews with farmers were also realized. Farmers use and manage riparian zones actively; use and management intensity depends of riverbed and riverbank with, and production modes. As research results are used for developing a participatory restoration strategy; a scoring analysis to select priority species for reforestation sites based on social and ecological values was elaborated. Both tree plant diversity and structural components, and farmer use and preferences were taken into account to assure community involvement and generate public interest in reforestation. As a result, 15 experimental small plots were established, involving surrounding farmers, which are to be considered as first experiences for developing a participatory restoration program within the watershed. The study finishes in discussing possibilities and challenges for restoration in the Ayuquila watershed from the sustainability perspective.

10:20 LA RESTAURACION DE LA VEGETACION RIPARIA Y VEGETACION SECUNDARIA EN PAISAJES TROPICALES FRAGMENTADOS
Ramos Prado Jose Maria

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El paisaje ripario es uno de los sistemas ecologicos mas complejos, ademas de que proveen multiples servicios ambientales. El sistema ripario de las subcuencas medias del Rio Tecolutla del norte de Veracruz presenta una serie de arroyos que tienen sus origenes en la sierra de Puebla y el Municipio de Zozocolco de Hidalgo. Este presenta drasticas perturbaciones de la vegetacion nativa y graves problemas de contaminacion, debidos principalmente al cambio del uso del suelo, a raiz del avance de la agricultura, la ganaderia y los asentamientos humanos. Esto influye en las caracteristicas estructurales de la vegetacion y en las propiedades fisicas y quimicas tanto del suelo como del agua del sistema.

Debido a la importancia de la zona y de los problemas actuales que presenta, surgio el interes en conocer el paisaje ripario en las subcuencas Tecuantepec-Tecacan, en particular la estructura y composicion de la vegetacion riparia y las comunidades secundarias. Para tal fin se caracterizo el uso del suelo y la complejidad de su vegetacion asociada.

Se observo una gran heterogeneidad en el paisaje estudiado (uso del suelo), reflejando el patron de desarrollo economico y de tenencia de la tierra en el area de estudio, en donde la agricultura, ganaderia y malas practicas del uso forestal han remplazado mucha de la vegetacion riparia original. Este estudio muestra la importancia de conocer el estado actual de la vegetacion riparia en los tropicos y considerar a las especies riparias nativas dentro de las practicas de restauracion ecologica de rios y cuencas.

Es importante promover el bosque secundario y cafetales como areas de amortiguamiento adyacentes a los rios, conciliando los intereses economicos, productivos y ecologicos como medida de manejo sustentable, manteniendo y/o conservacion los servicios ambientales que de estos sistemas ecologicos se derivan.

10:40 STRATEGY FOR AYUQUILA RIVER RESTORATION

Martinez R. Luis Manuel; Ortiz A. Claudia I.; Santana C. Eduardo; Garcia R. Salvador; Perez C. Gabriela; Graf M. Sergio; Gerritsen Peter R.W.; Contreras M. Sarahy; Santana M. Francisco J.; Iniguez D. Luis I.; Aguirre G. Angel; Olguin L. Jose Luis; Sand
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Present work represents the effort carried out in more than 10 years in the Ayuquila River. It describes the strategy developed to improve the conditions of the aquatic habitat through applied research associated with a process of environmental education, as a base for generation of citizen support for conservation of aquatic resources. An interdisciplinary group was integrated with expertise in botany, ecology of plants and animals, wildlife and watershed management as well as sociology studies. Inventories flora and aquatic fauna (fishes and aquatic invertebrates) and birds associated to the riverside area were carried out, as well studies about composition and structure of the

riverside vegetation. Studies in ecology of the kingfisher, fishes and river otter were developed to understand the habitat requirement of these species. Flow pattern, water quality and river geomorphology were studied to understand the dynamic of water through the disturbance affected by water pollution and river dewatering in Autlan-El Grullo valley. Related to social research, use and management of riparian areas were studies to understand how farmers manage these areas and to look for alternatives to solve streambank erosion and flooding. The results of these studies helped to decisions making about improvement of the aquatic habitat, as well as to know habitat requirements for fish, aquatic insects, kingfisher and otter. An important aspect of this research effort has been the long-term vision developed in the basin context.

11-00 Coffee Break

11:20 Use of Arbuscular Mycorrhizal Fungi for restoration of Tropical Rain Forest: a proposal model.

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Ecological restoration of tropical rain forest (TRF) allows going back to natural plant community, taking into account ecological processes and belowground organisms, such as arbuscular mycorrhizal fungi (AMF). The goal of this study was to analyze the AMF effects on survival and seedling growth of introduced non shade-tolerant and shade-tolerant species in grassland. After seed sowing in a shadehouse, seedlings were transplanted to pots and two factors were considered: soil (two levels: TRF and grassland) and inoculum (two levels: AMF (M+) and non-AMF (M-)). After 90 days seedlings were transplanted to grassland. Two sites, three plots and three replicates were used for each factors combination. Survivorship was measured during one year, and relative growth rate (RGR, g g-1day-1) was determined at the end of the study. For non shade-tolerant species, the highest RGR value was 0.01 and for shade-tolerant species was 0.005. Heliocarpus donnell-smithii and H. appendiculatus growth, was higher with M+ and TRFsoil (0.01 and 0.02, respectively). For Myriocarpa longipes, Cecropia obtusifolia and Piper auritum there were not significant differences. Shade-tolerant species, as Ficus yoponensis, and F. insipida grew higher with M+ and TRFsoil (0.015 and 0.01, respectively). However, Cordia megalantha had higher RGR values with M- and TRFsoil (‹?0.005); for Nectandra ambigens and Rollinia jimenezii no differences were observed. AMF increase growth and survival of non shade-tolerant species, whereas for shade-tolerant species the effect depends on each species. We proposed a restoration model based on different plant species responses to native AMF and on their life history traits. We suggest using: 1) plant species according to its role in succession, 2) specific site conditions that limit growth, 3) mycorrhizal dependence, and 4) inoculum AMF type. The results show that for restoration of tropical rain forest it is necessary to consider AMF.

11:40 Effects of stress treatments on Pteridium aquilinum in sites with arrested succession in the Lancandon Tropical Forest, Chiapas, Mexico

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P. aquilinum creates monospecific patches in areas intensively used under slash and burn agriculture. Once P. aquilinum dominates fields, succession is inhibited. One morphological attribute that makes P. aquilinum difficult to eradicate, is its persistent rhizome. In this study we evaluated the effects of casting shade and cutting the rhizome on above and belowground biomass of P. aquilinum in invaded fields in Lacandon Tropical Forest Chiapas. For the shade experiment we established six plots of 7 x 7 m in two different sites, and in each plot we established a central sub-plot of 3 x 3 m hereafter called sample area. Three plots in each of the two fields were covered with an 80 % shade net. For the rhizome cutting experiment we established 8 plots of 4 x 4 m in each site, with a similar sample area as in the shade experiment. In both experiments we estimated mean frond height, density and biomass, and rhizome biomass as response variables. Measurements were taken before treatments, and one year after the shade experiment, and six months after for the rhizome cutting experiment. The shade treatment had not an effect on the density or height of fronds of P. aquilinum ($F=0.775$, d.f. =2, $P>0.05$ y $F=6.646$, d.f.=2, $P>0.05$ respectively), or on its rhizome biomass ($F=0.086$, d.f.=2, $P>0.05$). The rhizome cutting treatment reduced frond biomass ($F= 4.469$, d.f.= 2, $P<0.05$). In both treatments we observed differences between sites. The treatments tested in this study proved insufficient to reduce P. aquilinum populations, at least for the time considered for this study.

12:00 Effect of herbivore exclusion on seedling community in successional oldfields in La Selva Lacandona, Chiapas, Mexico

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Tropical forests have been disappearing as a result of the extension of the farmland boundary, but because of the accelerated loss of soil fertility, many of these cleared areas are abandoned after a few years. The natural forest regeneration process in these sites can be very slow or even become arrested, which implies that active human intervention is needed to accelerate recovery. It is important to understand the mechanisms that limit regeneration to make intervention as efficient as possible. We evaluated the hypothesis that mammal herbivory constitutes a mechanism which structures the plant community during the successional proccess, with the capacity of slowing down the natural regeneration of the tropical humid forest. Herbivory exclosures were established in a set of oldfields with different ages since abandonment, and in a mature forest, in the Selva Lacandona, Chiapas, Mexico. The main objective was to evaluate the effect of mammal exclusion on the recruitment and mortality of seedlings and, ultimately, on the structure and dynamics of the woody seedling community. After one year, mammal exclusions increased the survival probability of newly recruited plants, but not of pre-existing seedlings, in all sites. Exclusions also augmented recruitment, but

only in sites with 8 to 21 years of abandonment and in the mature forest. The difference in community structure between excluded sites and controls was not significant, however there was a trend towards higher richness in the 8-21 years old sites while the reverse was true in the mature forests. The results suggest the influence of herbivory on seedling community structure differs with succesional age. It is an important cause of seedling mortality in mature forests and in late succession, but in early stages of forest regeneration in oldfields other factors are probably more important as successional mechanisms

Biological & Social Bases for Sustainable use of NTP. Part I

Room 8: Enrique Shuls (Second Floor)
Building: Colegio Primitivo de San Nicolás de Hidalgo
Monday July 16

10:00 Assessment of Sustainable Leaf Harvest from the Understory Palm, Chamaedorea radicalis

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Long-term demographic studies of non-timber forest products (NTFP) are necessary to accurately assess sustainability of extraction and can be used to derive rapid assessment methodologies. Here we develop a rapid assessment protocol for Chamaedorea radicalis, an understory palm in northeastern Mexico whose foliage is harvested for use in the international cut-greens industry.

The classical determinant of harvest sustainability is the finite rate of population growth (lambda), with a lambda<1 considered to be unsustainable. Thus, we developed a stepwise regression model relating lambda to vegetative, reproductive and population-level variables from a five-year demographic study across leaf harvest treatments in the El Cielo Biosphere Reserve, Mexico. The resulting model (r2=0.8023 and p<0.0001) included the proportion of seedlings in a population and the total adult fecundity as the strongest predictors of population growth. The model was then applied to 21 populations of C. radicalis throughout El Cielo, using measurements collected from a single season. The predicted estimates of lambda ranged from 0.93 to 1.18, but 18 of the 21 populations had prediction intervals bracketing the net replacement rate of lambda=1. Practical implementation of this rapid assessment protocol is thus limited by the imprecision of the population growth estimates.

We then explored whether measurements of annual transition rates provides a superior assessment. A fixed-design Life Table Response Experiment (LTRE) revealed that the observed differences in lambda across harvest treatments and years were primarily attributed to annual growth from the small to large adult life history stage and fecundity of large adults. However, these two variables explained a comparable amount of the variation in lambda across treatments (r2=0.7962) and implementation would require more intensive data collection. Therefore, assessment of these annual demographic rates would not provide a superior method of estimating lambda, and thus harvest sustainability, than one-time ƒ?~rapid assessmentƒ?T measures of population structure.

10:20 Effect of silvicultural management on population dynamics of Polaskia chichipe (Cactaceae) in the Tehuacán-Cuicatlán Valley, Mexico

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The purpose of our study was to evaluate whether traditional agro-silvicultural management practices affect the population dynamics of the endemic columnar cactus P.chichipe. The study was conducted at the tropical arid Tehuac n Valley in central Mexico. We assessed the practices used by local people to selectively increase the number of selected individuals when land is cleared for agriculture. Size structure, survival, growth, and fecundity rates were described in 1.5 ha plots and compared between wild and managed populations. Projection matrix models were used to estimate the population growth rate ($\bar{\times}$) and the relative sensitivity of $\bar{\times}$ to changes in stage-specific vital rates for each population. Furthermore, we assessed the effects of different hypothetical scenarios of cacti and fruit removal rates on $\bar{\times}$ to explore possible sustainable harvesting regimes. The managed population showed a faster population growth ($\bar{\times}$: 1.05) than the wild one ($\bar{\times}$: 1.04), suggesting that the traditional agro-silvicultural management favors the persistence of P. chichipe. Population structure of managed population was dominated by adult individuals (38%), which allows for a higher percentage of sustainable fruit harvesting (nearly 80%). In contrast, population structure of wild population was dominated by non-reproductive individuals (72%) which allows a lower percentage of fruits harvesting. In conclusion, our study indicates that: i) the agro-silvicultural management of P. chichipe populations does not endanger the persistence of the species, and ii) this practice enables an increase in the amount of harvestable fruits. Because the documented traditional system is under transformation (due to external cultural influences), we believe that the preservation of this system is crucial as a conservation initiative of P. chichipe and for maintaining a highly valuable natural resource for local people.

10:40 Use of Amazonian floodplain trees

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With about 1,000 tree species, Amazonian white-water (varzea) forests are the most species-rich floodplain forests worldwide. Due to its high nutrient status combined with the easy attainability by means of the rivers, the varzea is the most densely populated ecosystem within the Amazon basin. The conversion of forests into agricultural areas and unsustainable logging practices endanger biodiversity and ecosystem integrity of varzea forests particularly in the more densely populated eastern part of the basin.
Although many floodplain inhabitants preserve an intimate knowledge of the floodplain resources, few information is available about the traditional and commercial utilization of floodplain trees within the Brazilian Amazon, where most of the inhabitants are descendants from colonists. Community-based forest management thus restricts resource utilization often to selective logging of few timber species of commercial interest.
We investigated the traditional and commercial use of the 186 most common varzea tree species across the Amazon basin, using information from: a) herbaria b) literature, and c)

forest management projects in the Brazilian Amazon. Our results indicate that 73% of all investigated species are useful to the floodplain inhabitants and/or extractors. The overwhelming part of useful species provide non-timber forest products (NTFPs), where the most important fraction are phyto-medical extracts from trees. Other NTFP (i.e. latex, edible fruits, fish baits, hunting poisons) are restricted to few species, but can locally be of economic importance. Approximately 42% of the investigated species provide timber, the overwhelming part being locally used for house and boat construction. Despite expected use conflicts, we think that both sustainability and profit can be maximized when the integration of NTFPs in community-based forest management projects would be strengthened. Additionally, alternative timber species with high wood qualities should be integrated in these projects in order to minimize exploitation pressure on species populations in primary forests.

11-00 Coffee Break

11:20 Functional responses to repeated defoliation in three commercially exploited palm species of the genera Chamaedorea from mexican tropical forests

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Leaves of xate palms are an important Non Timber Forest Product (NTFP) for the local economy in Mexico rainforest areas. Current commercial exploitation has conducted to a dramatic decline of the xateï̈s natural populations. Three species constitute the major proportion of leaf harvesting in Mexico: Chamaedorea elegans, C. oblongata and C. ernesti-augusti. Here we used these species to asses the effects of different experimental levels defoliation (applied every six months during a year) on survival, growth, and reproduction of harvestable palm individuals at the La Selva Lacandona, Chiapas. In general, low defoliation levels (below 33% of total leaf number) induced overcompensation responses in leaf production and growth, compared to control group, while mild and severe treatments (beetween 50% and 100%) showed a complete compensation regarding leaf production. These results imply that the palms have capabilities to overcome the loss of foliar tissue, at least during the first year of harvesting. However, leaf length (important for commercial purposes because of minimum
sale sizes) and reproductive output (including probability of reproduction, inflorescences/individual, fruits/individual, and even fruit and seed weight in C. ernesti-augustii) in all species suffered a significant decline in the most severe defoliation treatments (between 66% and 100%). Such negative effecs of high defoliation may compromise the sustainable use of these species as a viable NTFP, as it: i) reduces the availability of commercial leaves and ii) deter the regenerative potential of natural populations under exploitation. We suggest that the sustainable leaf harvest levels are under 50% of standing leaves harvested every six months.

11:40 Demographic analysis of the impact of illegal extracton of heart of palm from Euterpe precatoria in Costa Rica.

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The Neotropical palm Euterpe precatoria Mart. (Arecaceae) experiences significant human pressure for the extraction of its heart of palm throughout its latitudinal range of distribution. In many protected areas of Costa Rica, illegal extraction is concentrated on the tallest individuals (19-21 m). Euterpe precatoria is a monopodial species, and thus, the extraction of heart of palm implies the death of the individual. Here, we developed a demographic analysis based on stage projection matrices for populations of E. precatoria in Braulio Carrillo National Park and La Selva Biological Station. We analyzed the demographic behavior of both populations and the consequences of the extraction of reproductive individuals using stochastic models for projections of 20 years. The growth rates across all life stages were higher in Braulio Carrillo in comparison to La Selva. At La Selva, differences in growth rates between primary and secondary forests were no significant, but total palm density and the number of new recruits were higher in secondary forests. The deterministic growth rate (lambda d), was higher than the average stochastic growth rate (lambda s) in all cases. The higher the value of lambda, the stronger its reduction. This was especially important in Braulio Carrillo (lambda d =1.075, lambda s = 1.018). In the La Selva secondary forest values were lambda d =1.02 and lambda s = 0.9954. The primary forest population at La Selva was the only one with decreasing lambda values (lambda d = 0.9798, lambda s = 0.9725). These simulations indicate a very slow recovery after an isolated event of intensive extraction, and demonstrate the high vulnerability of this species to continuous extraction. Our analysis demonstrates the need for more detailed and site-specific demographic studies to assess the vulnerability of palm populations to human disturbances.

12:00 Management options for the endangered, micro-endemic palm, Sabal pumos based on demographic analyses and harvester surveys.

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The endangered palm, Sabal pumos, is restricted to the lower Balsas basin, in Michoacan, Mexico. Very little is known about demographic and life history traits in this species. We analyzed demographic parameters in order to establish the factors leading to population decline. In addition we explored options of sustainable harvesting. For these purposes, we first established the actual geographic distribution of Sabal pumos based on exploration of the lower Balsas and using GIS methodology. Then, we established permanent plots classified into two treatments, perturbed versus successional stages, and followed dynamics for two years. We analyzed demographic dynamics using transition matrices‹?©‹?ÿ In order to establish the critical transition stage affecting the population growth rate, lambda (L)‹?ÿ‹?ª‹?ÿwe performed elasticity analysis

for each treatment. The L ‹?ÿof successional plots were higher than perturbed‹?ÿ(L= 0.9721; L= 0.9353, respectively). Elasticity analysis indicated that seedling recruitment and juvenile establishment were the most critical stages affecting L. Our observations coupled with information from harvesterƒ?Ts interviews indicate that fire and soil tilling are the main factors causing the lack of recruitment. We use demographic and sociological information to suggest management options for the palm.

Population and Community Ecology of Tropical System. Part I

Room 9: Aristóteles (Second Floor)
Building: Colegio Primitivo de San Nicolás de Hidalgo
Monday July 16

10:00 Effect of the physical environment and land use history in the structure and composition in a sub-tropical dry forest in Puerto Rico
Agosto-Diaz Ramon
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Forests in the sub-tropical dry life zone of Puerto Rico had recovered after diverse human and natural disturbances. This study document the variability in structure and composition in the Commonwealth Guanica Forest as a function of environmental and human factors. Sample sites were selected from a geographical information system database that includes a combination of land use history and topography. Sampling procedure started in January 2007 and is ending in late April of the same year. A forward selection method employing a Monte Carlo permutation test will be applied to select the set of variables that best explains variability in species composition. A canonical correspondence analysis ordination on species abundances will be done to detect relationships to site variables selected by the test. I expect differences in structure of the vegetation between sites of different environmental variables. The land use history will influence the floristic composition of sites. A subset regression analysis will be used to determine the best predictors of species richness, diversity, basal area, density and average height of the ten most important tree species at each plot. If this model results precise in predicting plant communities, it will be an important tool for conservation, management and future decision making.

10:20 PLANT COMMUNITY STRUCTURE UNDER AND OUTSIDE TREE AGGREGATES IN â?o CAMPO CERRADOâ?? (SAO PAULO â?" BRAZIL)
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We studied the plant community structure under and outside the canopy of tree aggregates of Pouteria torta (Mart.) Radlk. (Sapotaceae) and Hancornia speciosa Gomes (Apocynaceae). These aggregates form vegetation islands in a stand of ƒ?oCampo Cerradoƒ?? (22ø00ƒ?T and 22ø15ƒ?T South; 47ø45ƒ?T and 48ø00ƒ?T West) at the Ecological Itirapina Station in Sao Paulo, Brazil. It is a seasonal climate region, precipitation may reach 5mm in the dry season and 257mm in the rainy season, the soil is deep and composed by quartz sand, the plant community is frequently exposed to fire action. Three hypotheses were formulated: 1ø- plant diversity which occur under tree canopy are differentiated from surrounding vegetation; 2ø- under these tree aggregates the habitat structure differentiated from the surroundings; 3ø - Poaceae cover and woody sapling density are differentiated between Pouteria torta and Hancornia speciosa islands.

To test such hypotheses 30 islands of Pouteria torta e Hancornia speciosa were selected, by studying herbaceous-layer composition including all life forms, site microclimate, some chemical and physical properties of soil, and litter dry weight. Plant species composition/quantification and habitat structure parameters were ordinated by detrended correspondence analysis and there was a clear separation between samples inside Pouteria torta and Hancornia speciosa islands; samples from the surrounding vegetation were totally mixed. A two-way ANOVA detected that grass cover (F=9.417; p=0,00) and woody density (F=18.82; p=0,00) were significantly different into the two types of islands. The two first axes of the principal components analysis (accumulated variance=52.43%) separated the in and outside samples. Temperature was more correlated with the first axis; organic matter, phosphorus and photosyntetic radiation with the second axis. The analyses support the three hypothesis test, which is an indication that species guilds may be responding differently to tree islands that settle ƒ?oCampo Cerradoƒ?? patches in Itirapina Ecological Station .

10:40 Determinants of tree species spatial distribution in a neotropical forest
Garzon Lopez Carol Ximena ; Olff Han; Jansen Patrick; Bohlman Stephanie
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Tropical trees display distributional biases according to physical conditions across different spatial scales. These patterns are often interpreted as evidence for niche differentiation, where different tree species are specialized to certain habitat conditions. Some studies have indeed shown certain associations between tree species distributions and edaphic factors, topography and gap formation, but other studies have shown evidence for dispersal limitation as an explanation for the distributional patterns observed. To test relationships between species distribution and soil factors, species distributions and soil properties need to be mapped at large enough scales so it comprises entire communities and heterogeneity in soil factors.

Using a novel approach combining high-resolution satellite images and even higher resolution aerial photographs, we identified individual crowns of entire adult populations of four tree species (Attalea butyracea, Astrocaryum standleyanum, Dypterix panamensis and Jacaranda copaia) across 1500 ha of tropical moist forest at Barro Colorado Island, Panama. We determined the relative importance of deterministic processes (niche differentiation) in the spatial structure of these tree populations by analysis of tree distribution maps and environmental variables. We found strong correlations with forest age in the spatial distribution of two species. At smaller scales, other variables became important in explaining the tree species spatial distribution. Our results show a high degree of determinism in the distribution of species at large spatial scales. However, this determinism decreases with scale, suggesting an increasing importance of stochastic processes.

11-00 Coffee Break

11:20 Palm Community Structure and Land Cover Changes in the San Juan Biological Corridor, Costa Rica

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Biological corridors connect forest fragments, minimize the isolation of remaining habitats, and reduce the negative impact of fragmentation. Important studies in a corridor include documentation of land cover and the relationships between the plant community and land cover changes. In this study, density, species richness, and species diversity of palms of different life stages and growth forms were documented in forty 10 X 10 m census plots in the San Juan Biological Corridor (SJBC), Costa Rica. Changes in the percent cover of agricultural, partially forested, and forested lands from 1979-2001 were quantified based on existing land classifications. The associations between these palm community characteristics and the reduction in forest cover in 200-m and 1000-m annuli surrounding the census plots were investigated. These palm community characteristics were spatially interpolated to examine their distributions in SJBC. The community characteristics of palms of all growth forms varied among census plots. Forested lands in SJBC decreased from 88 percent to 26 percent from 1979-2001, while the percentage cover of agricultural and partially forested lands increased. The annual deforestation rate was 0.8 percent from 1979-1992, 4.3 percent from 1992-1997, and 7.5 percent from 1997-2001. Overall, palm community characteristics of small canopy palms, dwarf palms, and cotyledonous seedlings had lower values with a lower percentage forest cover. The spatially interpolated palm community characteristics were consistently greatest within or adjacent to protected areas. This study demonstrates the complexity of the landscape and the effect of loss of adjacent forests on the palm community.

11:40 Impacts of ancient Maya forest gardens on the tree species composition of Northwestern Belize

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For millennia, the Maya culture exerted selective pressure on Mesoamerican tree species composition. I propose that ancient Maya ƒ?oforest gardensƒ?? altered the tree species composition of forests due to centuries of intensive management, and will test the hypothesis that these effects can still be detected today. I predict that tree species composition will differ significantly between high (HSD) and low (LSD) ancient settlement density areas and that modern forest in HSD areas will have greater evenness values than forest with little or no evidence of settlement. I compared tree species composition of HSD and LSD areas in forests around the ancient Maya city of El Pilar, Belize. Similarity of species composition was greater within groups (LSD or HSD) than between groups (LSD vs. HSD, Chao-Jaccard 0.67 and 0.57, respectively, with non-overlapping confidence intervals). Neither LSD nor HSD rarefaction curves, however, approached a species richness asymptote, arguing for the need for a larger number of samples. Total richness (including undetected species) for LSD and HSD plot sets was estimated resulting in a significantly higher estimated richness in the LSD plots (299 species vs. 173 species, no overlap in confidence intervals). This research brings quantitative, ecological rigor to the question of the longƒ?"term impact of ancient Maya forest gardening on tree species diversity.

12:00 Tropical swamps in the Gulf of Mexico, relationship between geomorphology, hydroperiod and plant diversity.

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We studied five tropical swamps in the coastal plain of Veracruz along the Gulf of Mexico. We monitored the level of inundation during the period march 2005-march 2007. With these data we obtained the hydroperiod for each swamp. Two types were distinguished: one had peaks of inundation coupled with the rainy season and in the other the level of inundation was maintained for a long period of time (6-9 months). The sites that show inundation peaks are located in the floodplains(Cienega del Fuerte and La Pompal); the sites in which inundation last a long period are found on the base of coastal dunes (La Mancha and El Salado), with the exception of a swamp that neighbors a coastal lagoon (Laguna Chica). SÇôrensens similarity index for Cienega del Fuerte and Apompal is 41.5 (they share 17 species) and for Laguna Chica, Mancha and Salado is between 26.7 and 31.3 (they share 8 - 10 species). The most common tree species were Pachira aquatica, Inga sp., Ficus obtusifolia, Annona glabra, and some patches of mangrove elements such as Rhizophora mangle, Laguncularia racemosa and palms. This study shows the importance of the hydroperiod in the ecological processes of the swamp forests as well as the relationship with the dominant species in each community type. The conservation and management of tropical swamps should take into account the maintenance of water fluxes and hydroperiods. Periods of inundation and dry conditions control physico-chemical processes, the productivity of the system, as well as the ecology of the biota that establish in each community type.

Ecology and Seed dispersal. Part I

Room 10: Manuel Altamirano (Second Floor)
Building: Colegio Primitivo de San Nicolás de Hidalgo
Monday July 16

10:00 The importance of figs and fruit-eating birds in anthropogenic ecosystems: a transcontinental comparison
Caughlin Trevor; Wheeler Jessica H.; Ganesh T.; Lowman Margaret
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Fig trees, long recognized for their importance in natural forests, have key roles in urban ecosystems. Hemiephytic figs may be particularly successful in urban environments due to seed dispersal by a wide range of animals, the ability to recruit in a variety of environments and cultural significance in human societies. The stability of the fig frugivore mutualism may contribute to a homogenous global assemblage of animals and fig species. As urbanization increases worldwide, the influence of figs and human-commensalist frugivores on ecosystem dynamics is also likely to increase. We studied the interaction between figs and fruit-eating birds in South India and South Florida by quantifying bird visitation patterns and consequences of seed dispersal in both areas. Figs in India and Florida were visited by similar assemblages of disturbance-resistant birds, with several bird families, including Corvidae and Sturnidae, shared between sites. However, the ecological consequences of fig/bird interactions differed between the two areas. In South India, figs are some of the few trees left standing after pervasive deforestation. Tree seedling abundance and species richness were significantly higher beneath isolated remnant trees than in open areas, indicating a potential role for fig trees in reforestation projects. In contrast, fig frugivory in South Florida is likely to increase biological invasion by plant species. These results demonstrate that while human disturbance may lead to biotic homogenization, species shared between regions are likely to have different effects on local ecosystems. Further research on fig frugivory in anthropogenic landscapes will contribute to biodiversity conservation.

10:20 A trade-off between attraction and protection in bird dispersed fruits
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Fruit traits evolve in response to an evolutionary triad between plants, seed dispersers and antagonists that consume fruits but do not disperse seeds. A trade-off between defense against pests and attraction to seed dispersers may have important consequences for seed dispersal. We evaluated how nutrient contents and secondary compounds affect fruit removal and persistence time of flesh fruits on a subtropical land-bridge island in Sao Paulo state, southeastern Brazil. We selected 8 to 10 individuals of

14 bird-dispersed plants to test the defense trade-off hypothesis. We prevented fruit removal by covering 4 branches with a net and left another 4 branches available to birds. The survival of ripe fruits was drastically different among species for bagged and open fruits and all fruit species persisted longer when protected by frugivores. Fruit traits influence survival rate of bagged and open fruits, whereas fruits with high lipid and energy contents persisted for a short period of time, fruits with high phenol and tannin contents persisted for longer periods in both treatments. In our study, fruit removal was mediated by the stimulating effects of energy and lipids contents and the deterring effects of phenol and tannin. The removal-rate model of the trade-off hypothesis states that profitable fruits are quickly removed and contain low levels of secondary compounds and thus explains the found pattern. Since the content of secondary compounds also affected the persistence time, our results corroborated the assumptions that secondary compounds increase persistence time preserving fruits against microbial and invertebrate pests, which can be particularly advantageous for plant species that depend on rare or unreliable seed dispersers or survival in degraded landscapes with low abundance of frugivores.

10:40 Are scarlet macaws (Ara macao) and mealy parrots (Amazona farinosa) redundant pre-dispersal seed predtors? Evidence from the Osa Peninsula, Costa Rica

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Psittacids represent the highest biomass of volant granivores in Neotropical areas. Some studies have shown that sympatric parrots can share a high number of plant species in their diet, suggesting that they may be redundant pre-dispersal seed predators in tropical regions. Scarlet macaws and Mealy parrots are the largest psittacids in the tropical humid forest of the Osa Peninsula, Costa Rica and are sympatric. The goal of this study is to determine if these two species are redundant seed predators in this region. I documented seed predation of these two psittacids using feeding bout observations during systematic trail walks in two habitats (coastal and interior forest). During the preliminary six month assessment 132 feeding observations were registered; 125 correspond to seed predation events (71 macaws and 52 parrots). These two psittacids had a very specialized diet with low niche overlap. Only three of the 24 seed species preyed upon by these two psittacids were shared. Combretaceae species were the most important seed resource used by macaws, while Elaeocarpaceae was the most common tree family in the diet of parrots. Macaws preyed on more seeds of animal-dispersed plants, while parrots preyed on more wind-dispersed plants. Neither of the two species showed preference for a particular fruit size. Moreover, macaws were observed feeding more in coastal forest, while parrots were observed more in inland forest. These diet differences and feeding habitat preferences suggest that these sympatric psittacids are not redundant as seed predators in tropical areas, and further, suggest that the disappearance of either of these species could have potential implications on tropical forest dynamics.

11-00 Coffee Break

11:20 Secondary dispersal by dung beetles and fate of Rollinia edulis (Annonaceae) seeds

dispersed by two primate species in the Serrania Las Quinchas, Colombia.
Santos-Heredia Maria Carolina; Andresen Ellen; Zarate-Caicedo Diego Alejandro
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The study of post-dispersal seed fate is crucial for understanding the effects of primary seed dispersers on plant regeneration. We studied the interaction between seeds of the tree Rollinia edulis (Annonaceae), two of its primary primate dispersers (Ateles hybridus and Alouatta seniculus), and dung beetles (Scarabaeinae) as the secondary dispersers, in a tropical rainforest in Colombia. First, we compared the assemblages of dung beetles attracted to the dung of both primate species using pitfall traps. More species and more individuals were captured with Alouatta dung than with Ateles dung. A total of 481 individuals and 44 morpho-species were captured with Alouatta dung, while 396 individuals and 36 morpho-species were captured with Ateles dung. Second, we evaluated the effects of type of dung (Alouatta vs. Ateles), and defecation pattern (clumped at sleeping sites vs. scattered at random locations) on the secondary dispersal of seeds by dung beetles and on seed fate, using a factorial experiment. Each seed was individually marked with a nylon thread, and surrounded by 5 g of fresh monkey dung. A total of 220 seeds were used in the experiment. Dung type and defecation pattern affected post-dispersal seed fate of R. edulis, with more seeds being buried by dung beetles when surrounded by Alouatta (68%) vs. Ateles (53%) dung, and more seeds buried when in a clumped (68%) vs. a scattered (53%) defecation pattern. Burial depth, horizontal movement of seeds and seed predation were not affected by dung type or defecation pattern. Since seed burial is known to often increase the probability of seedling establishment, and both dung type and defecation pattern affect the probability of seed burial, it is important to take these aspects into consideration when assessing the seed dispersal quality associated with a primary disperser.

11:40 SECONDARY SEED DISPERSAL BY DUNG BEETLES IN RAINFOREST SITES WITH DIFFERENT LEVELS OF HABITAT DISTURBANCE IN SOUTHERN MEXICO
Ponce-Santizo Gabriela; Andresen Ellen
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Many studies evaluate the direct effects of habitat disturbance on species of plants and animals. However, fewer studies evaluate the higher-order effects of disturbance, such as effects on biotic interactions and ecological functions. Secondary dispersal by dung beetles of seeds defecated by primates is a common biotic interaction in tropical forests, and seed dispersal plays and important ecological role in plant regeneration. In this study we determined the effects that different levels of habitat disturbance have on secondary seed dispersal by dung beetles. We used five study sites with different disturbance levels in a tropical rainforest landscape at the Marques de Comillas region in the state of Chiapas in southern Mexico. First, we assessed differences in dung beetle assemblages among sites using pitfall traps. Then, we measured the activity of dung beetles as secondary seed dispersers with a field experiment using howler monkey dung and plastic beads to mimic defecated seeds. Dung beetle richness, abundance and diversity

decreased in disturbed sites, compared with the undisturbed forest. Site area, degree of isolation, vegetation characteristics, and resource availability affected the composition and structure of dung beetles assemblages in the study sites, however no clear pattern was detected with any of the explanatory variables explored. Rather, it appears that the mechanisms that explain changes in these dung beetles communities are not independent and can act in a synergic or antagonistic manner. Results from the seed-fate experiment showed that the dung-removal rate and the burial rate of beads did not vary among sites, but the horizontal distance of bead movement was higher in the undisturbed forest than in the disturbed sites. Using a logistic regression we found that seed dispersal (both horizontal and vertical movement of seeds) by dung beetles had a significant positive relationship with dung beetle abundance and species richness.

12:00 Influence of seeds and fruits on the abundance of small rodents and their relationship with seed predation and dispersal of the araucaria ¦_pine¦_ Araucaria angustifolia in the Araucaria Forest

Vieira Emerson M.; Iob Graziela; Kindel Andreas; Seger Guilherme
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Plant species that oscillate in their fruit and seed production may influence on their predators and dispersers, changing their responses in years with high or low resource offer. Araucaria angustifolia is the main element of the Brazilian Araucaria Forest. Its seeds are largely consumed by the mammalian fauna, including rodents. The aim of this study was to evaluate the relationship between rodent abundance and fruit availability as well as Araucaria angustifolia seed availability. We also evaluated if seed production influences rates of predation and dispersion of araucaria seeds. We conducted the study in an area of Araucaria Forest in southern Brazil. In this area, we selected eight forested study sites, four of them covered by native vegetation (Araucaria Forest) and four were planted forests with A. angustifolia. We sampled the rodents in each season (autumn, winter, spring, summer). To evaluate the amount of fruit production, in each site we recorded all fruiting individuals in transects monthly between Jan/06 and Jan/07. We also evaluated the araucaria seed predation and dispersion between May/06 and Aug/06. Our results showed that Araucaria seeds are an important resource in the area, mainly in winter, on which fruit availability on the ground was lower. Rodent abundance was higher during winter and summer. We detected low removal rates in planted areas, where overall seed availability on the ground was higher. The survival rate of the seeds was also higher in these areas. Our results indicated that predation changes according to density, with seed removal being lower in areas with higher seed production. In areas with higher rodent abundance, we detected lower removal rates, which suggest predator satiation. Such strategy might have consequences for recruitment and conservation of A. angustifolia, as well as for the predation and dispersion dynamic, in case of inadequate management of this species.

Effects of forest Fragmentation on Tropical Systems

Room 6: Sala 2 (Second Floor)
Building: Centro Cultural Universitario
Monday July 16

14:00 Population density of Dipteryx panamensis, the food and nesting tree of the endangered Great Green Macaw (Ara ambigua) in Costa Rica
Chun Sara Lai Ming; Carranza Sanchez Jorge
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Dipteryx panamensis is a canopy-emergent, keystone tree species endemic to the lowland Atlantic rain forests of Nicaragua, Costa Rica, and Panama. It is the primary food and nesting resource for the endangered Great Green Macaw (Ara ambigua), which persists in fragmented populations from southern Nicaragua to northwestern Colombia. A new national park known as Maquenque has been proposed to protect the last breeding habitat for the Great Green Macaw in Costa Rica, as approximately 25-35 breeding pairs and 200 individuals persist in the country. Maquenque forms the core of the proposed San Juan-La Selva Biological Corridor. This Corridor would link protected areas in southern Nicaragua to central Costa Rica and provide contiguous habitat for far-ranging species like the Great Green Macaw. Despite this visionary conservation project, little is known about the population and spatial distribution of D. panamensis within the Corridor. In order to evaluate the status of D. panamensis and therefore habitat for the Great Green Macaw, we conducted an aerial survey of the entire 250,000-hectare Corridor during the peak flowering period for D. panamensis to ascertain its population and density. This remote sensing effort resulted in over 2,000 digital photos. An automated pattern recognition and classification technique within a GIS framework was used to identify and count blooming D. panamensis trees visible in the photos. The data provide a landscape perspective for this tree species and indicate that it exists in much denser patches than previously determined from small, field-based studies. The results highlight priority conservation and habitat restoration zones for the Great Green Macaw within the Corridor. The research also validates a novel and relatively inexpensive remote sensing technique that can elucidate conservation questions over large, inaccessible tropical landscapes.

14:20 Establishment and growth of two tropical rain forest arboreal plant species in the context of a fragmented landscape: The role of Arbuscular mycorrhizal fungi.
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Inoculation with arbuscular mycorrhizal fungi (AMF) has shown the ability to augment the establishment and growth capacity of arboreal plant species in the restoration of deteriorated tropical forests. We have evaluated the effect of AMF inoculation originating from two different sizes of tropical rainforest fragments on the survival and growth of two

arboreal plant species: Pleuranthodendron lindenii and Pimenta dioica. Our hypothesis was that saplings would survive and grow more successfully with AMF originating from a large tropical rainforest fragment due to greater species richness found in other experiments. Saplings of the two species were planted near the edge of two small (3 ha) fragments of tropical rainforest surrounded by pasture in the region of ƒ?oLos Tuxlas,ƒ?? Veracruz, Mexico. Three treatments were applied to the saplings; a control with no AMF (M-), AMF inoculation from a large fragment of tropical rainforest (MG), and AMF inoculation from a small fragment of tropical rainforest (MCH). We measured survival, sapling growth, leaf number and leaf survival for eight months (July 2005 to February 2006). We found statistically significant results for survival and growth variables between the inoculated saplings and the control and relatively few differences between the two types of inocula. Inoculated plants of P. lindenii showed greater survival (89%) height ($F(2,84\ df)=3.77$, $p=0.0270$), and diameter ($F(2,84\ df)=4.95$, $p= 0.0093$) and P. dioica presented greater survival (59%), biomass ($F(2,84\ df)=5.36$, $p= 0.0064$), leaf area ($F(2,84\ df)=7.26$, $p=0.0012$), and net assimilation rate ($F(2,84\ df)=13.57$, $p= 0.000008$). Inoculated plants of P. dioica presented a greater total number of leaves with the MG treatment ($F(2,84\ df)=6.0537$, $p=0.003$). We have concluded that AMF inoculation is a good option for strengthening the survival and growth of saplings and should be included in restoration projects in the tropical rainforest.

14:40 Species and structural composition of church forests in a fragmented landscape of Northern Ethiopia

Wassie Alemayehu; Sterck Frank; Bekele Tesfaye; Teketay Demel; Bongers Frans
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In Northern Ethiopia, while almost all dry afromontane forests have been converted to open agricultural lands, thousands of small isolated fragments remain around churches (ƒ?ochurch forestsƒ??). We assessed the species and structural composition of these forests and investigated whether and how this composition varies with altitude, forest area and human influence. 28 forests with a total of 500.8 ha were selected at different altitudes (range 1816 to 3111 masl) and of various sizes (range 1.6 to 100 ha).
A total of 168 woody species (100 tree species, 51 shrub and 17 climber) representing 69 families were recorded. Forest differed strongly in species number (15 to 78), basal area (4.8 to 111.5 m2/ha), number of individuals ƒ%¾ 5 cm dbh (267 to 1553/ha), number of individuals >1cm diameter (619 to 2421/ha) and number of seedlings (0 to 5263/ha).
Basal area decreased with wood harvest but was independent from altitude, forest area and cattle interference. Species dominance increased with altitude and cattle interference. The ratio understory to upperstory density decreased with cattle interference but was independent of altitude and forest area. All species richness measures and diversity indices decreased with altitude, but were independent of forest area, cattle interference and wood harvest.

Similarity between forests decreased with altitude difference between forests, but geographical distance hardly explained variation.
We conclude that altitude is the main factors determining species composition while human influence determines structural composition of these forests. Particularly cattle grazing strongly determines forest structure and species composition in the understory and is expected to have a strong longer-terms effect on whole forest structure and

composition. Forest area has no significant effect on structural and species composition. This implies that although large size forests are a necessary element of successful conservation, small patches and appropriate matrix management could be useful complements.

15:00 Coffee Break

15:20 Rainforest Loss and Resultant Changes in the Avifauna of Palenque, Chiapas
Patten Michael; Gomez de Silva Garza Hector; Smith-Patten Brenda
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Human populations have increased dramatically over the past several decades, leading to pressure to develop or farm land and a concomitant acceleration of the rate of tropical deforestation. How native organisms respond to habitat loss and fragmentation has been the subject of intense study in temperate ecosystems and at several tropical sites in Central and South America, but there has been little study of this phenomenon in Mexico, the country bridging the Neotropics and temperate North America. In addition to specimen data going back over a century, we present analyses of qualitative data collected over the past 35 years at Palenque, Chiapas, a popular destination for visiting birders. These data were compiled to provide presence/absence in each year from 1970 to 2006 and were tested statistically by species using methods to determine the probability of species loss given such a sighting record. As recently as the late 1950s Palenque*ƒ*?Ts forest were contiguous with those of La Selva Lacandon to the south, but the protected area surrounding the famous ruins is now a forested island. As a result, various species formerly known from the site have disappeared, including species both large (Penelope purpurascens, Crax rubra, and Sarcoramphus papa) and small (Notharchus macrorhynchos, Malacoptila panamensis, Microrhopias quixensis, and Pachyramphus cinnamomeus) and various other forest birds have declined significantly. By contrast, several species of open areas or second growth have colonized the area (e.g., Thryothorus modestus, Mimus gilvus) and other such species have increased. In agreement with studies from Central America (e.g., La Selva, Costa Rica, and Isla Barro Colorado, Panama), extinctions and declines are most common among small-sized forest insectivores and mid-sized frugivores.

15:40 EFFECT OF TREE DIVERSITY AND DISTANCE TO FOREST INTERACTION ON BIRDâ?TS IN SILVOPASTORAL SYSTEMS, MATIGUAS, NICARAGUA
Ramirez Leonardo R; Harvey Celia A; Casanoves Fernando; De Clerck Fabricio
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Although the importance of silvopastoral systems to the conservation of birds is well recognized, there are few studies that investigate the combined effect tree diversity, and the landscapes position of these systems on avian diversity. These two features of silvopastoral systems are critical in biodiversity conservation, design and planning at

landscape levels. The objective of this study was to determine and evaluate the combined effects of tree diversity and the distance to the nearest forest patch for trees dispersed in pastures, as well as the effect of tree diversity, and connection to a forest patch for live fences on resident avifauna of Matiguas, Nicaragua. Using point counts, we registered avian diversity and abundance twice a day (morning and evening) during both the rainy and dry season in 24 pastures, and 24 live fences selected for the study. We calculated avian abundance, species richness, and the Shannon index of diversity in all treatments and used completely randomized two-way ANOVA to compare differences between the treatments. During the study, we registered a total of 3,506 individuals pertaining to 94 species from 28 families. We found one endangered and three threatened species. The most common feeding guild observed was the insectivorous species. We found that tree diversity was correlated to avian diversity for both the trees in pastures as well as for the live fences. However, we failed to find any significant effect of distance to the nearest forest patch or to the connectivity of live fences to forest patches. It is probable that while the Matiguas landscape is highly fragmented, it remains sufficiently connected to eliminate the effect of distance.

Restoration of tropical ecosystems. Part II

Room 7: Miguel Hidalgo (Second Floor)
Building: Colegio Primitivo de San Nicolás de Hidalgo
Monday July 16

14:00 Recruitment potential of isolated trees in tropical pastures of Southeastern Mexico
Garcia-Orth Ximena; Martinez-Ramos Miguel
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We studied seedling recruitment under the canopy and in the vicinity of four isolated trees in abandoned tropical pastures in Chiapas, Southeast Mexico. We fenced an area of 1ha around each isolated tree and categorized 4 distances to the tree*ƒ*?Ts trunk: canopy (5m), 10m, 20m, and 48m into the open pasture. At each distance category, we applied four grass treatments in order to alter competition with pasture grasses. These were a) control (no alteration whatsoever), b) superficial biomass cut with machete, c) herbicide application, and d) removal of above- and below-ground biomass with a gardening hoe. Seedlings of native tree, shrub, and liana species were registered every 3 months for 2 years. Seedling recruitment varied significantly among sites: Ficus A - 57%, Ficus B - 15%, Inga A - 3%, and Inga B - 25% (of a total of 799 recruits). Recruitment was significantly higher under the tree*ƒ*?Ts canopy (ca. 50%), while the rest of the distance categories recruited less than 25% seedlings each. Relative recruitment was higher in the treatments where competition was partially or completely eliminated. Recruits were bigger in the control treatment and under the focal tree*ƒ*?Ts canopy. Twenty one tree, 21 shrub, 2 vine, and 4 liana species were recorded. Fifty four percent of the recorded seedlings were from shrub species, 35% were tree species, and ca. 4% were vine and liana species. Animal-dispersed species accounted for 658 seedlings, while 141 seedlings were from wind-dispersed species. The most abundantly recorded genera were Inga, Solanum, Vernonia, and Cordia. Our results suggest that previous land use (i.e. exotic grass density and fire use) strongly determine the site*ƒ*?Ts regeneration ability when abandoned, more than microclimatic conditions.

14:20 Interindividual variation in phenology and seed production within a stand of three tree species
Armijos Claudia; Gunter Sven; Moreira Maximo
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One of the major obstacles for the restoration of degraded mountain forest ecosystems in Ecuador is the lack of a sustainable management of high quality seed material of native tree species. Our goal is to analyze the phenology and seed quality and quantity among individuals with different DBH and social positions of Cedrela lilloi, Vismia tomentosa and Tabebuia chrysantha. In combination with forest inventory data we will estimate the

potential seed production of the tropical mountain rainforest of the San Francisco Scientific Station in Southern Ecuador. Phenological observations have been carried out every two weeks for the last four years for 20 individuals of each species. The seed production was quantified by randomly collecting ten representative branch samples per tree, and the seed quality was tested under controlled conditions according to the ISTA Rules. At the moment we analyze the impact of light exposure within the crown of tree individuals on seed quality and quantity.
The results reveal differences in the occurrence, the intensities and the timing of flowering and fruiting among individuals with different DBH, as well on the seed quality (size, purity, moisture content and viability). We noticed differences in seed quantity and quality between the observation years as well. We can conclude so far that DBH can be an indicator of the seed production on the monitored stand; and we could find a relationship between quantity and quality of the seeds. Additionally we identified and characterized tree individuals of each studied species as potential tree seed sources into the native forest.

14:40 Endangered island floras: fast growth rates and short lifespans create significant challenges for conservation and restoration of the Hawaiian lobeliads

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The Hawaiian lobeliads represent a spectacular example of adaptive radiation in plants. Descended from a single ancestor, they have colonized habitats ranging from closed-canopy wet montane rain forest to open, subalpine bogs and dry sea cliffs. Many species are also extremely rare, with 35% of extant taxa considered globally threatened or endangered. Significant on-going conservation and restoration efforts exist including fencing plants from invasive herbivores (deer, sheep, goats, pigs), monitoring of rare populations, collection of seed from rare species, propagation in botanic gardens and restoration planting. Such strategies all have the ultimate goal of establishing of viable and genetically diverse populations. Unfortunately, no data exist on key parameters critical for understanding long term population trajectories (e.g. individual growth rates, plant longevity, population vital rates). Such information is critical for designing long-term conservation strategies. As a first step, we examined height growth rates in 11 species of lobeliads and used those data to estimate individual plant age in our populations. We also related growth rates to measured physiological rates of the same individuals. Height growth ranged from 0.7 cm per month in Cyanea pilosa, a species that inhabits shaded forest understories, to 2.6 cm per month in open, cliff dwelling Lobelia yuccoides. Average estimated age of individuals in our populations ranged from 6.9 to 27 years old. Height growth was strongly positively related to mass-based assimilation rates but not to light environment. Anecdotal information on lack of recruitment of these species due to fruit predation by rats and slugs combined with our data showing relatively rapid growth rates and short plant lifespans suggest that significant challenges exist for designing sustainable management and long-term restoration of field populations of this group. We end by examining possible conservation and restoration strategies based on successful models from other threatened island floras.

15:00 Coffee Break

15:20 EVALUATING ARTIFICIAL REEFS FOR CORAL RECUITMENT IN PUHAWANG AND MUNA ISLANDS OF INDONESIA

Widiastuti Endang; Kanedi Muhammad; Natha Frans
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Coral reef ecosystem of Indonesia has been degraded for many years which affected the economy of many traditional fishermen. Puhawang and/or Muna Island were an example of islands that their coral reefs have been degrading with the percent of living corals varies from 46% to 58% depends on the water depth. In order to conserve the existing coral reefs, concrete artificial reefs with different shape, cylinder and pyramid-like, were placed in 2 different depth of water (5 m and 17 m), surrounding the degraded coral reefs. In two - five years later these artificial reefs were observed and evaluated for any attracted reef biota (for coral recruitment). The results indicated that in Puhawang Island, after 5 years of implanted, 50.42% of total area was covered by coral (38.75%) and its associate (11.67%). From total coral genus, 47.06% coral genus of surrounding reefs were able to be recruited in artificial reefs, addition to it, 6 other genus were also found. These recruitment was dominated by Goniastrea sp and Porites groups of scleractinia Meanwhile, after 2 years of implanted, in Muna Island, 66.67% coral genus were able to be recruited from surrounding reefs, in addition to other 5 genus were also found. Mostly, the biota recruitment was dominated by sponges (spongia/tunicate) while for the corals was dominated by Goniastrea sp.

Biological & Social Bases for Sustainable use of NTP. Part II

Room 8: Enrique Shuls (Second Floor)
Building: Colegio Primitivo de San Nicolás de Hidalgo
Monday July 16

14:00 Managing mistletoe in an NTFP-based livelihood system
Rist Lucy; Uma Shaanker R; Milner-Gulland EJ; Ghazoul Jaboury
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The fruit of Phyllanthus spp., locally known as Amla, is non-timber forest product of significant livelihood importance in Southern India. In the Biligiri Rangaswamy Temple (BRT) Wildlife Sanctuary in Karnataka, infection of Amla trees by a hemiparasitic mistletoe threatens the sustainability of harvesting and may have significant consequences for population persistence and dependant livelihoods.

We carried out forest surveys to assess the prevalence and characteristics of mistletoe infection in the Amla population and we assessed the effectiveness of the Forest departments*f*?T current management strategy, removal of mistletoes by hand. We also investigated an alternative local approach to mistletoe control, cutting of infected branches. This behaviour, which is linked to the Amla harvest, has previously been criticised as destructive and motivated by short term economic considerations. Harvester interviews provided new information on the rationale behind this behaviour and also historical information on the mistletoe population and its recent and potential future impacts on Amla resource availability.

Our results suggest that mistletoe infection is widespread within the sanctuary, possibly having increased dramatically in recent years as a result of a changing fire regime. Branch cutting was more effective in eliminating mistletoes than hand removal, at least in the short term, and may have additional benefits in reducing future infection risk and increasing fruit production through coppicing. This approach is likely, however, to be only a partial solution, with multiple and possibly interacting factors, including fire, grazing, invasive species as well as harvesting, affecting resource sustainability. Researchers and forest managers need to work with local harvesters in designing and evaluating management practices that can contend with all threats to sustainability in NTFP harvesting.

14:20 Selection of sexually produced seedlings of a clonally propagated crop in a traditional Amerindian agroecosystem
Duputié Anne,; Massol Fraçois,; David Patrice,; Haxaire Claudie; McKey Doyle
CEFE/CNRS UMR5175 - 1919 Route de Mende - 34293 MONTPELLIER CEDEX 5 - FRANCE; CEFE/CNRS UMR5175 - 1919 Route de Mende - 34293 MONTPELLIER CEDEX 5 - FRANCE; CEFE/CNRS UMR5175 - 1919 Route de Mende - 34293 MONTPELLIER CEDEX 5 - FRANCE; CEFE/CNRS UMR5175 - 1919 Route de Mende -

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--This abstract could also fit into topic "Ethnobiology: application in biodiversity conservation" --
The Wayapi Amerindians of southern French Guiana cultivate about 80 cassava landraces. Cassava (Manihot esculenta ssp. esculenta) is propagated clonally, but still produces seeds, which are recognized by farmers as belonging to one of their already existing landraces. Nevertheless, only some seedlings actually are incorporated into the farmerƒ?Ts stock of stem cuttings for their landraces. Thus, although landraces are mostly not monoclonal, they are usually made up of a few clones. Like other Amerindians, the Wayapi usually plant cassava in monovarietal patches, a practice that favours inbred matings. Pujol et al. (2005) showed that Palikur Amerindians of eastern French Guiana unconsciously selected the most heterozygous seedlings by weeding the others. The Wayapi do not weed - probably because weeds are less of a problem in the longer fallow periods they practice - and incorporate seedlings into landraces regardless of their heterozygosity.
However, they apply another form of selection: the seedlings that actually are chosen to be incorporated into a landrace are the ones that show the highest genetic relatedness with the landrace. Genetic variation among cassava clones is thus maintained in a way that preserves the genetic homogeneity of most varieties. The most inbred of the new clones may be eliminated after, not during, their incorporation into the stock of cuttings, which occurs in the few years during which the farmers still recall which plants of their plants are issued from seeds.
Differences in farming practices between the Palikur and the Wayapi thus affect the microevolutionary dynamics of cassava landraces. Both cases suggest lessons that may have general applications in the wise management of clonally propagated crops.

14:40 Coffee as a biodiversity host in its center of origin
Hylander Kristoffer, Nemomissa Sileshi
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Recent studies, mainly from Latin America, have shown that agroecosystems with shade grown coffee can serve as important refuges for certain parts of the rainforest plant and animal biota. In its center of origin, in SW Ethiopia, coffee Coffea arabica grows in both montane rainforests and in different agroforestry systems. Despite being its center of origin for one of the worldƒ?Ts most important cash-crops, very little attention has been paid to these forests and the different agroforestry systems in Ethiopia in terms of its conservation status and importance for forest biodiversity. We compared the epiphytic diversity in 15 random forests and 15 random coffee homegardens with shade trees in SW Ethiopia. On average the diversity on single coffee shrub level was similar between the forests and the homegardens for mosses (3.9 vs. 3.3 species) and vascular epiphytes (0.7 vs. 1.2) whereas the liverwort diversity was significantly lower in the homegardens (9.9 vs. 5.9). If the whole plot of 200 m2 was considered the forests contained much more species than the homegardens with the biggest difference among the liverworts (30 vs. 14 species). The variation among plots is, however, large and there are examples of very species rich homegardens and species poor forests as well. There

was a clear turnover in species composition between the two different site-types, but to large extent the species composition in the homegardens was a subset of the species found in the forest sites. Our results show that agroforestry systems could be very important for the forest biodiversity in the landscape and should be included in evaluation of the conservation status of forest biodiversity.

15:00 Coffee Break

15:20 Is productivity of cacao impeded by epiphytes? An experimental approach

Sporn Simone Goda; Gradstein Robbert; Bos Merijn
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Due to conflicts with economic interests of farmers, implementations of conservation policies in cultivated habitats often fail. In the case of the common agroforestry crop cacao, epiphytic layers are thought to cause harvest losses and are therefore threatened by the widespread, time-consuming practice of epiphyte removal. We experimentally approached the impact of epiphytes on cacao productivity in agroforests in Central Sulawesi, Indonesia. In a balanced full factorial design, we investigated the effects of epiphyte removal on fruit-set success and eventual yields on 80 trees. The removal treatment had no significant effect on the eventual harvest of the cacao trees. Pollinator availability had the greatest impact on fruit-set success, whereas yields were mainly determined by site-specific factors that mediate fruit-abortion and occurrence of fungal diseases. The results illustrate that epiphytic flora dominated by non-vascular species may have no effects on cacao tree functioning and removal of non-vascular epiphytes is unnecessary for improving the productivity of cacao. Hence, farmer's labour can be reduced and conservation of the rich biodiversity outside natural forests supported.

15:40 Sustainable forest use in Brazilian extractive reserves: natural regeneration of Brazil nut in exploited populations

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The emergence of Brazilian extractive reserves reinforced the notion that sustainable forest use could play a central role in conservation. Brazil nut is considered a model non-timber product for promoting conservation through use. Demographic studies, however, have demonstrated differential impacts of nut harvest on Brazil nut population structure. Comparing three populations with different forest use histories, degrees of road access, and recent levels of nut harvest, we asked: (1) Are they exhibiting regeneration failure? and (2) Are seedling/sapling densities explained by adult Brazil nut structure, fruit fate and/or overall forest structure? We installed four 9-ha plots in each site to census Brazil nut trees ƒ%¾ 10 cm dbh, and within each plot, 36 25 x 25 m subplots to quantify regeneration, overall forest structure, and open and closed fruit counts. Approximately 29

to 55% of fruits was unharvested, and more than 90% of these was opened by scatterhoarding dispersers. Population structure approximated a reverse-J size class distribution, with seedling densities varying from 3.2 to 5.8 individuals ha-1. We conclude that within the current harvest context, regeneration is sufficient for population persistence in our sites, at least over the medium term. The socioeconomics of sustainably managing Brazil nut is the greater challenge, involving interlinked competitive land uses, nut quality, and substantial increases in local income from harvest. Some of these challenges are being addressed in Brazil, Bolivia and Peru, providing hope that this cornerstone extractive species will continue to play a prominent role in the ecological and economic landscape of Amazonia.

Population and Community Ecology of Tropical System. Part II

Room 9: Aristóteles (Second Floor)
Building: Colegio Primitivo de San Nicolás de Hidalgo
Monday July 16

14:00 Patterns of floristic differentiation among Atlantic forests and the influence of climate II: The southern scenario
Oliveira-Filho Ary; Jarenkow Joao Andre; Budke Jean Carlos
Universidade Federal de Lavras; Universidade Federal do Rio Grande do Sul; Universidade Regional Integrada do Alto Uruguai e das Missoes Erechim
ary.oliveira.filho@gmail.com

We investigated the influence of both space and climate on the composition of the tree flora of the southern section of South American Atlantic forests (latitude 20ø to 36øS). To this end, we performed multivariate analyses on 273 checklists discriminating the contribution of climatic and spatial variables to the overall variation in plant species distribution. We analyzed the whole set of 273 forest areas as well as subsets corresponding to subtropical forests, rain forests, araucaria forests and seasonal forests. Additionally, we analyzed the same sets in terms of species richness of genera and families. We found significant relationships between tree species composition and climatic variables in all analyses, although their contribution to the overall variation ranged between 21-27%. Likewise, the relationships with spatial variables were all significant and ranged between 17-25%. Nevertheless, climatic and spatial effects were inseparable in 10-17% of overall variations. We detected three main consistent gradients in species distribution: (a) from tropical to subtropical forests, related mainly with decreasing temperature and increasing annual temperature range; (b) from rain to seasonal forests, related mainly with either decreasing rainfall and increasing temperature range; and (c) from forests at lower altitudes to montane forests, particularly araucaria and cloud forests, related mainly to decreasing temperature. Among subtropical areas, rain forests were related to higher summer rainfall and lower annual ranges of both temperature and rainfall while the opposite was found for seasonal forests; araucaria forests and cloud forests were related to higher altitude and lower temperatures (with extreme values for the latter) although their annual temperature range was similar to that of rain forests. The patterns found for genera and families were consistent to those shown by species suggesting that climate has played a key role on the evolution of tree taxa in the southern extremes of Atlantic forests.

14:20 Community structure of bracket fungi (Polypores) and shelf fungi in Southeast Asia
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Bracket fungi (Polypores) and shelf fungi play important roles in decomposition processes in tropical rain forests. This group contains over 2600 species in the world, and we expect that many species would exist in tropical region and that they would finely

divide their host substrate among fungal species in according to the size and decay stage of coarse woody debris (CWD). Although a few studies on community structure of bracket fungi and their relatives were conducted in Central America and Southeast Asia, more study is needed. In this study, we aimed to estimate the number of species of bracket fungi and to reveal host utilization pattern in a primary rain forest in Sarawak, Malaysia. We collected fruiting bodies from 12 transects (100 x 10 m) and from the sides of a 5-km trail in the Lambir Hills National Park. We counted the number of CWDs from which fungal fruiting bodies appeared as an indicator of abundance. A total of about 100 species were collected from over 800 CWDs during survey period. Amauroderma subrugosum, Flabellohpora licmophora, Ganoderma australe, Microporus affinis and M. xanthopus were dominant species. Fruiting bodies of A. subrugosum appeared on the ground. On the other hand, fruiting bodies of G. australe formed on thick fallen trunks (> 30cm in diam.), where as those of the other dominant species formed on thin branches (< 15cm in diam.). We will show the estimated number of species and discuss traits of community structure of this fungal group in this region in comparison with those of boreal and temperate regions.

14:40 Change in spatial distribution patterns of five species in a landscape in Chajul, Mexico

Salinas-Melgoza Miguel Angel; Martinez-Ramos Miguel; Rodriguez-Velazquez Jorge Enrique
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We evaluated the change in spatial point pattern (SPP) for the most abundant and frequent species in the Lacandon tropical rain forest in southeast Mexico after 11 years. SPP for 1994 was compared to that for 2006 among habitats differing in both soil type and topography. The hypothesis underlying this study is that populations undergoing competitive thinning will shift their spatial pattern. We collected one set of tree locations for both 1995 and 2006 for all individuals ƒ%¾ 10 cm (DBH) of Ampelocera hottlei, Brosimum alicastrum, Brosimum costaricanum, Dialium guianense and Guarea glabra. The locations of the individuals were based on a X-Y coordinate system for 14 plots. We used the (K) Ripley function, a second-order statistics based on the distribution of distances of pairs of points, which describes the small-scale spatial correlation structure of the point pattern. We set 20 intervals of 1 m, and run 1000 Monte Carlo simulations to test the null hypothesis of a Poisson pattern from the actual data. These 5 species were represented in 18 populations for all the 14 plots in both 1994 and 2006; from these 18 populations, four maintained the same patterns, two populations of Ampelocera hottlei in alluvial terrace, one in low-hill and the last one in flood plain. Each species exhibited a heterogeneous point patterns. The analysis of the spatial pattern reveals changes at several scales. The analysis of the resulting spatial structure may indicate the existence of underlying intraspecific and interspecific competition, disturbance, herbivory, or environmental heterogeneity effect, apparently operating at different spatial scales. Such processes and forces seem to affect the dynamic of juvenile recruitment and adult mortality. The interactions between plants of different species, age or size play an important role in the dynamic of an ecosystem and can induce specific spatial structures.

15:00 Coffee Break

15:20 Comparing canopy accession of Cedrela odorata in a tropical dry and moist forest using tree rings

Brienen Roel; Zuidema Pieter; Martinez-Ramos Miguel
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Growth patterns of tropical forest trees are strongly governed by temporal variation in light availability, which may differ substantially between tropical dry and moist forests. Dry forests are generally lower with an open canopy, while moist forests are higher and more closed. Hence, trees in the understory of these forests differ in light availability and in spatial and temporal variation in light when growing towards the canopy. This has probably important repercussions for the role of gap formation in successful canopy recruitment in both forest types.
We use tree rings to investigate whether canopy accession patterns of Cedrela odorata differ between a dry, semi-deciduous forest in the Yucatan Peninsula of Mexico and a moist, semi-evergreen forest in the Bolivian Amazon. In the dry forest, light availability of equal sized trees is higher and the canopy is lower (15-25 m vs. 25 ƒ?"35 m). We hypothesized that trees in the denser moist forest show more and longer-lasting periods of suppressed growth (i.e. relative slow growth) and more growth releases (i.e. relative strong growth increases) until reaching the canopy compared to the dry forest.
Evaluation of growth patterns until reaching the canopy do not show the expected differences in the length or frequency of suppressions, but we do find small differences in the number of growth releases until reaching the canopy (0,8 in dry against 1,2 in moist forest). Division of trees into different canopy accession patterns shows that in the dry forest a larger portion of trees grew steadily into the canopy, while in the moist forest a larger portion shows canopy attainment through repeated growth releases. This indicates that gap formation is probably more important for successfully reaching the canopy in closed moist forests than in dryer open forests.

15:40 Spatial variation in palm fruit abundance across a tropical moist forest estimated from aerial photographs

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Fruit abundance is a critical factor in ecological studies of tropical forest animals and plants, but difficult to measure at large spatial scales. We tried to estimate spatial variation in fruit abundance on large spatial scales using low altitude, high-resolution aerial photography. We measured fruit production for all 555 individuals of the arborescent palm Astrocaryum standleyanum across 25 ha of mapped tropical moist forest on Barro Colorado Island, Panama, by visually counting fruits from the ground. Simultaneously, we used high-resolution aerial photographs to map sun-exposed crowns of the palm across the same area, and linked those to ground-mapped stems. First, we verified whether crown presence and crown area on aerial photos were associated with fruit crop size at the level of individuals. Then, we determined how well spatial variation in Astrocaryum fruit density across the study area was predicted by remotely-sensed

densities and areas of sun-exposed crowns compared to ground-mapped densities and diameters of stems. We found that both the likelihood and area of crown exposure on aerial photographs increased with individual fruit crop size. Although representing just one third of all individuals in the study area, the crowns visible on the photos represented 57% of all fruits produced. The spatial pattern of remotely-sensed crowns was strongly correlated with the spatial pattern of fruit abundance based on direct fruit counts, and correctly showed the areas with the highest and lowest fruit abundances. Crown density predicted spatial variation in fruit abundance equally well as did stem density. Weighting by crown area did not improve the prediction. Our study indicates that remote sensing of crowns can be a reliable and cost-effective method for estimating spatial variation in fruit abundance across large areas.

16:00 REINTRODUCTION OF THE THREATENED JAVANESE PALM Pinanga javana Blume

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Pinanga javana Blume is one of the Indonesiaƒ?Ts attractive, endemic palms that can be used as a flag species to promote conservation of the remaining Javanese mountain ecosystems. The significant decline of its populations has nationally become a major concern. The species now only consists of six, small, scattered populations confined to the sub-mountain areas of Java that have been extensively converted into major plantations and human settlements. The potential for recovery will depend largely on the type and degree of active management to be applied to existing individual populations. This paper discusses efforts to restore the threatened palm focusing on its reintroduction and monitoring. In 2005, a total of 5200 seedlings have been reintroduced to the former habitat at the Gunung Halimun National Park (West Java) at 16 different potential locations, covering a wide range of forest and habitat types. The results showed that the palm requires specific environmental conditions for establishment. The survivorships and growth conditions varied with habitat types. Based on the tagged individuals (after one year planted), the highest survivorships (87%) and the best growth conditions occurred in well-drained sites adjacent to water supplies with moderate to steep slopes, moderate canopy cover (60-70%), clear understorey, and with an average humidity of 79% and soil pH of 6.4. In contrast, high mortality rates and less growth conditions were experienced by individuals planted on barren, degraded sites or under closed-canopy covers. The lowest survivorship recorded was 27%. A number of pests were found to attack the planted individuals, particularly slugs, rhino beetles and grasshoppers. The material transport method seemed to cause some stresses and injuries, leading to the deaths of some of the planted plants. To effectively manage the planted seedlings and conserve the remaining populations, it is crucial to protect the suitable sites in the national park.

Ecology and Seed dispersal. Part II

Room 10: Manuel Altamirano (Second Floor)
Building: Colegio Primitivo de San Nicolás de Hidalgo
Monday July 16

14:00 Phenology, frugivory and seed dispersal of Aniba rosaeodora var. amazonica Ducke (Lauraceae): and endangered tree of the central Amazonian terra firme forest
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Since the 19th century, the Brazilian Rosewood Tree (Aniba rosaeodora) has been exploited for its essential oil (linalool), which is used world-wide as a fixative in the perfume industry. Trees are cut down to obtain the oil, and the intensity of such exploitation has resulted in A. rosaeodora*ƒ*?Ts severe population decline. To assist in its conservation, we present here a study of Rosewood reproductive biology, based on data from 20 trees over 36 years. The flowering pattern of wild-growing trees is irregular, with 10 flowering records and eight fruiting records in 36 years. Fruiting trees produce 148 to 2,560 fruits, experience a high level of seed removal (mean 59%: range 13.5-76%: n = seven trees), and have birds (especially toucans: Rhamphastidae), as their primary seed-removal agents. Fruit removal was positively related to fruit set ($r = 0.978$, $df = 5$, $p < 0.0001$), but fruit set was not related to percentage of removal ($p > 0.05$), most likely due to A. rosaeodora*ƒ*?Ts strategy of maturing low densities of fruits over very extended periods. This fruiting strategy seems to be associated with dispersal tied to a limited suite of specialized dispersers. Survey data indicated that the chances of seedlings reaching adulthood increased with distance from the maternal tree. This result emphasizes the key role of seed-dispersing birds in any Rosewood regeneration program, as well as underscoring their key role in maintaining the species*ƒ*?T genetic variability. Faced with the fact that this commercially-important tree is threatened with extinction, urgent measures must be taken to maintain the survivorship and genetic variability of Rosewood populations. These should include: (1) locating representative native populations; (2) creating protected forest areas; and (3) implementing management plans within forest reserves where extraction occurs.

14:20 COMMUNITY-LEVEL DISTANCE EFFECTS ARE PERVASIVE THROUGH MULTIPLE STAGES OF TREE RECRUITMENT IN AN AMAZONIAN RAINFOREST
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We examined recruitment patterns of multiple tree species in an Amazonian floodplain forest at three ontogenetic phases: seed rain, seedling survival, and sapling distribution, in relation to conspecific adult locations.

Using a high-density array of seed traps, we confirmed that seedfall decreases sharply with increasing distance from adult trees, with disproportionately large contributions from a very small fraction of seed-producing trees.

A parallel experimental study that employed >1300 individual seedlings of 15 common tree species situated near and far from conspecific adults revealed significantly higher survival at far sites, for more than half of the species used. Survival analysis based on multiple censuses revealed that a ƒ?odistance effectƒ?? persisted and intensified over time, while the time of onset of distance-related mortality differed amongst species.

Spatial point-pattern analysis of the distributions of adult trees and conspecific sapling recruits of multiple species revealed that recruitment is significantly skewed towards greater distances from conspecific adults. When compared against random arrays of points, significantly more saplings than expected recruited further away from adults. Saplings of many species, particularly animal-dispersed, shade-tolerant ones, recruited in areas of very low predicted seed density at significantly higher rates than expected under a null hypothesis of ƒ?oall seeds are equalƒ??.

Overall, our results provide community-level support for the ƒ?odistance-dependenceƒ?? prediction of the Janzen-Connell model through increasing adult-progeny spacing through successive early life history stages. Seed dispersal appears critical for successful recruitment, and undispersed seeds make a minimal contribution. When de-coupled from distance-dependence, effects of density-dependence on recruitment were weak or undetectable. We conclude that tropical tree recruitment in the presence of an intact fauna conforms closely to predictions of the Janzen-Connell hypothesis.

14:40 The fitness advantage of long distance dispersal: results of a long-term genetic study of Jacaranda copaia.

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Studies of the ecological mechanisms maintaining high tropical forest tree species diversity have long focused on spatial processes that regulate species abundance and distribution. Chief among these are density and distant dependent dispersal, recruitment, growth, and survival. Dispersal, the process that determines the initial template of plants against which distant and density dependent agents act, has remained difficult to study in natural systems because of problems associated with tracking the fate of large numbers of seeds from multiple individuals. Genetic parentage analysis of dispersed seeds and recruits provides one powerful solution to examining patterns of dispersal, recruitment, and survival in space.

In this presentation, I will present results of a long term study examining spatial patterns of seed dispersal and recruitment of the pioneer tree Jacaranda copaia within the 50 ha forest plot on Barro Colorado Island, Panama. I used microsatellite markers to determine the dispersal distance of > 750 wind-dispersed seeds in 2000 and 2002 across the forest plot. These distances are used to derive a dispersal curve that demonstrates mean dispersal distance on the order of 50 m. Microsatellite genotypes from new recruits and all adult reproductive trees in 2005 were then used in a parentage analysis to determine the most likely parent pairs of new recruits. A recruitment curve fit to recruitment

distances reveals mean recruitment distances > 100 m. The results imply a fitness advantage to seeds dispersed long distances. Results are discussed in terms of the role of random (gap availability) and non-random processes (Janzen-Connell processes) in generating the observed recruitment curve. I will also briefly present data on how dispersal and recruitment create patterns of spatial genetic structure and some demographic consequences of spatial genetic structure to seed production in adults. Finally, I will discuss implication of these results to the maintenance of forest biodiversity.

15:00 Coffee Break

15:20 Pervasive predation of nutmeg (Virola koschnyi) seed by land crabs (Gecarcinus quadratus) in the Osa peninsula, Costa Rica.
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Land crabs and small mammals are terrestrial granivores in coastal and inland tropical rain forests. This study attempt to determine whether nutmeg seeds survival is affected differently by the change of land crabs density. Coastal rainforest is dominated by land crabs and their density drops toward inland. It was expected to find a greater rate of seed removal by crabs in coastal forest (crab zone) than in inland forest (f?ocrab-less$f$?? zone), while the opposite seed removal rate was expected to be found by small rodents. In addition, we were interested to determine the fate of seeds handled by land crabs. We used experimental seed stations (N=12) in both zones (N=6 per habitat). Coastal forests seed stations were located 50 meters from the ocean. Inland seed stations were located at 600 meters inland from the coastal stations. At each seed station, seeds were under three exclosure treatment: 1) large mammals, 2) land crabs, and 3) rodents and land crabs and 4) no exclosure. Each treatment had three threaded seeds with 1 meter fishing line and a 0.2 meter of pink flagging tape to locate them after removal. Coastal zone had a greater density of crabs than inland zone. After 10 days of the experiment, most seeds were removed from the open experiment. Seed removal rate comparison among treatments, and seed deposition location after removal, showed no evidence of rodent activity in both habitats. Rather, it suggests that land crabs removed the majority of seeds, and protection of seeds from land crabs increased their survival in our study site. In addition, all seeds removed by land crabs were destroyed and no nutmeg seedlings were found around the crab$f$?Ts burrows. This study suggests that land crabs play an important role in the early regeneration of nutmeg trees in the Osa peninsula, Costa Rica.

15:40 Dispersal dynamics affect the distribution, but not the abundance, of tropical trees: A study of tropical tree communities in Amazonian Peru
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The dispersal assembly perspective holds that dispersal dynamics are the primary determinant of the distribution and relative abundance of species. I present patterns in the distribution and relative abundance of tree species in Amazonian Peru and assess if

dispersal dynamics can explain these patterns. I censused tree communities in multiple habitat types at 14 locations across a 150 by 200 km area of Madre de Dios, Peru. I focused community censuses, and subsequent dispersal measurements, on the most abundant and diverse tree genus in the area: Inga (Mimosoideae, Fabaceae). Of 60 species found in the study area, all are absent from at least one census location. Based on data from soil analyses, some of these absences can be attributed to an unsuitable soil environment for a given species. However, in many cases, a species is absent from locations that have a soil type upon which the species has elsewhere demonstrated an ability to grow and survive. Limited seed dispersal across the landscape could explain why species are absent from these locations. An examination of the relative abundance data gives a different expectation for dispersal levels. Within a habitat type (floodplain or uplands), the relative abundance of species is strongly correlated across the landscape. Common species are consistently common, and rare species are consistently rare. If dispersal is determining the relative abundance of species, there must be high rates of dispersal across the landscape to explain this correlation. To estimate levels of seed dispersal across the landscape, I measured gene flow between populations (within species) for a chloroplast marker. This genetic data indicates that seed dispersal is very limited across the landscape. Thus, dispersal dynamics (i.e. limited dispersal) may be responsible for patterns in the patchy distribution of species, but it cannot explain the correlation of relative abundances across space.

16:00 Fruit-frugivore interaction in a Neotropical savanna: a megafauna-deprived land?

Donatti Camila; Galettti Mauro; Pizo Marco Aurelio; Guimaraes Jr. Paulo R.; Jordano Pedro
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Seed dispersers play a key role in the ecology and evolution of fleshy-fruited plants, especially in tropical forests, where from 70 to 95% of all woody species are dispersed by vertebrates. The Pantanal is the largest wetland in the world, located in Brazil, Bolivia and Paraguay. Large frugivores are vanishing from most areas in the world due to selective hunting or fragmentation, but are still abundant in the Pantanal. We studied the interactions between fruits and frugivores, including mammals, birds, tortoise and fish, through scats and stomachs analysis, camera trap monitoring and focal observations at fruiting trees. We also measured and described 93 species of fleshy fruits. Our data indicated that the high diversity of large, fleshy, vertebrate-dispersed fruits characteristic of the Pantanal is associated with the prevalence of seed dispersal by mammals, supplemented by other taxa such as birds, fish and reptiles. However, large-seeded species, the so-called megafauna fruits, are poorly fitted to extant seed dispersers and show reduced fruit removal. Their ability to persist with reduced dispersal is related to a combination of life-history traits: resprouting, seed dispersal by water, secondary seed dispersal by vertebrates, replacement of seed dispersers with exotic fauna or humans, or rare events of seed dispersal. In addition, for some of these large-seeded species, no alternative mechanisms need to be invoked to explain population persistence other than a combination of long lifespan and an ability to recruit close to parental trees.

Herbivory

Room 6: Sala 2 (Second Floor)
Building: Centro Cultural Universitario
Tuesday July 17

10:00 The influence of the endophytic fungi on diversity of herbivores in Baccharis dracunculifolia DC (Asteraceae).

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Endophytic fungi colonize internally host plants and protect them against herbivores and pathogens. The aim of this work was to evaluate the richness of endophytic fungi found among unfolded, recently expanded, and old leaves of Bauhinia brevipes (Fabaceae). Ninety leaves were collected from 15 individuals at the EstaCao Ecologica de Pirapitinga, MG, southeastern Brazil. In each individual, two leaves from each age were chosen. The leaves were sterilized, cut in fragments of 5X3 mm from petiole, midrib and leaf lamina of each leaf and transferred to Petri dishes with PDA (potato-dextrose-agar). We found 138 morphospecies of endophytes. The unfolded, recently expanded and old leaves presented 79, 93 e 102 morphospecies, respectively. The similarities (Jaccard*f*?Ts Index) among the leaves of different ages were: 0,509 between unfolded and recently expanded, 0,474 between unfolded and old ones and 0,492 between recently expanded and old ones. Some morphospecies were found only in specific leaf stages. In the unfolded leaves, six exclusive morphospecies were found, in recently expanded leaves, nine exclusive morphospecies were found, and in old leaves, 17 exclusive ones. Especially, Phomopsis sp1 was found in all leaf parts, in all stages and in almost all individuals collected (13 of 15). The increase of endophytic richness with leaf age is probably related to the presence of secondary compounds. Generally, old leaves exhibited fewer substances with antifungal properties and thus suffer a higher fungi infection. The presence of Phomopsis sp1 in all almost individuals studied indicates that this fungus can have strong mutualistic relations with B. brevipes, such as Neotyphodium endophytes from Festuca sp.

10:20 Plant cell suicide mimics herbivore damage

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Galling insects are a special type of internal herbivores that are able to induce galls and from inside this new structure redirect nutrients and photosynthates to a nutritive tissue at which they feed upon. Gallers may impose serious damage to their host plants distant from the feeding site. The galling larva is dependent on young leaves to be able to, more efficiently, induce a gall. Otherwise, young tissues are extremely important to the plant

as they represent important future sources of photosynthate. Perhaps a better strategy by the host would then be to annihilate the gall before it is even formed. Indeed, plants under the attack by galling herbivores are able to elicit a rapid and efficient response to the site under attack in which the cells around the galling site become rapidly necrotic and die; killing therefore the larvae. This phenomenon has been termed hypersensitive reaction. Field observations have indicated that the necrotic spot caused by the plant often falls off from the leaf lamina leaving a hole that resembles the damage caused by many external feeding herbivores. In a pioneer study, we report that Tapirira guianensis (Anacardiaceae) is attacked by one species of leaf galling herbivores in the tropical rain forest of Porto Trombetas, Brazil. The hypersensitive reaction to galling is easily seen as a necrotic spot around the site where the gall is attempted to be induced. Due to rapid leaf expansion, the dead necrotic tissue falls off from the leaf, leaving isolated or coalescent holes that are mostly indistinguishable from damage caused by free feeding herbivores and leaf pathogens. More than five times leaf area was lost by host hypersensitive reactions (range 0.1 to 8.59 cm2) compared to the area lost by free-feeding herbivore damage (range 0 to 1.53 cm2). The same trend was observed for the percentage of leaf area lost (Hypersensitivity: 0.31 to 52.55%; free-feeding herbivory: 0 to 14.07%). Because of the resemblance of the hypersensitive reaction damage with that caused by many free feeding herbivores and leaf pathogens and because the phenomenon seems to be general throughout several tropical biomes, we should proceed with caution when inferring damage caused by herbivores solely on marks left on the leaves at the end of the leaf expansion period.

10:40 Plant diseases as ecological drivers in plant community diversity: The importance of microclimate variation

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Plant diseases are thought to help maintain plant diversity through density-dependent mortality. However, the development of plant diseases depends strongly on climatic conditions. Both natural and human-generated changes in forest structure lead to spatial variation in microclimate that may in turn alter the impacts of disease. Diseases may play a greater role in reducing competitive exclusion and increasing plant diversity in forest understory sites with closed canopy and greater humidity than in forest fragments. As a consequence, reduced density-dependent disease may remove limits on competitive exclusion and lead to reduced plant diversity. I assessed the impacts of plant fungal pathogens on seed germination across twelve sites in intact lowland tropical rain forest and in remnant forest fragments at Los Tuxtlas Biosphere Reserve in Veracruz, Mexico. I evaluate whether mortality from pathogens was greater in darker and moister sites, and lower in forest fragments. I conducted seed germination experiments in the greenhouse and across all of the sites and fragments with nine common tree species, and used experimental manipulations to reduce (through fungicides) the impacts of disease. Fungicide treatment significantly increased seed germination across species in both greenhouse and field experiments. Seed germination was significantly different across habitat types (forest understory, gaps, and fragments). However, there was no significant interaction between fungicide and habitat type. These results suggest that in tropical forests, resource limitation may be more important than diseases in determining seedling success.

11-00 Coffee Break

11:20 Differential allocation of resources to reproduction, has consequences for growth and defense and herbivory in three sympatric species of Chamaedorea (Arecaceae) in Los Tuxtlas, Mexico

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Dioecious plants present contrasting resource allocation patterns between sexes. Female plants invest more into reproduction and less into growth than males. Allocation theory predicts a growth-defense tradeoff and we hypothesized males would: grow faster, be less defended against herbivores and exhibit higher herbivory than female plants. In addition, we hypothesized that juvenile plants, not having such a differential resource allocation to reproduction, would exhibit a unimodal inter-individual variation in growth, herbivory and defense. Using an adult male-female paired design with three sympatric Chamaedorea species (C. alternans, C. ernesti-augustii and, C. pinnatifrons) at Los Tuxtlas rainforest, we found that allocation to reproduction (proportional biomass) was consistently higher in female plants of three species. Also, in C. alternans, male inflorescences consumed more CO2 than female inflorescences, while female plants maintained a high demand of CO2 until fruit maturation occurred (i.e., during several months), thus requiring higher amounts of CO2 during the reproductive season. In concordance, female plants of all species significantly: grew slower, had tougher leaves, higher concentration of total phenolics and lower herbivory. On juvenile plants the frequency distribution of growth and defense were unimodal in C. ernesti-augustii and C. pinnatifrons, while herbivory was multimodal in all species. In general, allocation to defense was negatively correlated with herbivory (all three species), and resource allocation to defenses reduced growth in females of C. ernesti-augustii and C. pinnatifrons supporting the allocation trade-off expectation. Surprisingly, females of C. alternans, while investing more in reproduction than males, did not show a trade-off with growth. In conclusion the results suggest that differential allocation to reproduction between male and female plants of dioecious plants has consequences of great significance for the interaction of such species with their herbivores.

11:40 Are female plants better defended against herbivores than hermaphrodites in gynodioecious species?

German Avila; Mauricio Quesada
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Unisexuality is thought to evolve when a mutation that causes male- (or female -) sterility spreads through a population because the fitness of the mutant exceeds that of hermaphrodites. One potential advantage of unisexuality is the avoidance of inbreeding depression resulting from self-fertilization. However, unisexuality can also be advantageous to an individual if the suppression of a sexual function frees up resources

for other functions, including the remaining sexual function, growth and defence against herbivores and pathogens. In order to test whether the loss of a sexual function allows individuals to defend themselves better against herbivores, we have started a study using natural populations of the gynodioecious Cucurbita foetidissima in Central Mexico. This species can be heavily attacked by beetles of the genera Acalymma and Diabrotica (Chrysomelidae). Initially, we assessed leaf damage (a measure of resistance to herbivores), growth (nodes / day), and flower and seed production of 30 hermaphrodites and 30 females from a large population. Preliminary results show a trend for female individuals to have lower levels of damage than hermaphrodites. However, overall damage levels were low, with medians of 1% and 1.5% for females and hermaphrodites, respectively. At this point, there is weak support for the hypothesis that unisexual individuals are better defended than hermaphrodites.

Biodiversity Inventories and Conservation. Part I

Room 7: Miguel Hidalgo (Second Floor)
Building: Colegio Primitivo de San Nicolás de Hidalgo
Tuesday July 17

10:00 Angiosperm distribution patterns in the Neotropics: generating species ranges from monograph-based point-to-grid data

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It is not the question of whether but of how to analyse existing plant specimen data. Or rather, how to analyse existing plant specimen data taking into account the strengths and weaknesses of the data sources available. For the analysis of the distribution patterns of the flowering plants of the Neotropics, we estimated species richness and narrow endemism on the base of monographic data by interpolating species ranges from point-to-grid data. By rule-based interpolation (threshold distances between occurrences and elevation barriers) distribution ranges of approx. 4000 angiosperm species were determined. The species ranges were differentiated according to the weight that the presence/absence of each data point has for the result of the interpolation. Overlapping all weighted species ranges yielded centres of species richness and narrow endemism, which include well-known centres like the Andes as well as smaller centres distributed more or less regularly over the Neotropics. We identified areas particularly in need of protection since they harbour narrow endemic species but are without protection status according to the World Database on Protected Areas 2006.

10:20 How do individual species structure biodiversity in tropical forests

Huth Andreas; Wiegand Thorsten; Gunatilleke Savithri; Gunatilleke Nimal
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It is well known that tropical forests host tree species with a range of biological and physiological attributes which should leave detectable spatial signatures in the forest. We therefore expected that some species with facilitative attributes may increase diversity in its neighbourhood and others with more competitive attributes may tolerate lower number of species in its neighbourhood. However, our study based on the spatial patterns of hundreds of species in two contrasting forest dynamics plots in Sri Lanka and Panama revealed that these apparent differences among species leave a much weaker signature at the spatial structure of diversity than previously thought. Only at local scale < 20m two strongly different roles could be observed: diversity repellents dominated at Panama and accumulators at Sri Lanka. We hypothesize that the lack of spatial structures at larger scales is tightly related to the high diversity of tropical forests. Our results suggest revision of current concepts of mechanism which promote high diversity in tropical forests.

10:40 A comparison of diversity and distribution patterns of lichens, liverworts, mosses, and pteridophytes in Andean montane forests

Mandl Nicole; Lehnert Marcus; Kessler Michael; Gradstein S. Robbert
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We present the first comparison of diversity and distribution patterns of the four main cryptogamic plant groups (lichens, liverworts, mosses, pteridophytes) in tropical mountain rainforests. We analyzed patterns of alpha diversity (i.e., species richness) and beta diversity (i.e., species turnover), and asked the question whether specific taxa may be used as surrogates for other cryptogamic groups. At three localities in southern Ecuador we surveyed terrestrial and epiphytic cryptogamic assemblages on ridge and slope forests in 28 plots of 400 mý each. The epiphytic habitat was significantly richer in ferns, liverworts, and lichens than the terrestrial habitat; only mosses were primarily terrestrial. Patterns of alpha diversity were congruent for ferns and liverworts in both habitat types, mosses only showed similarities with ferns and liverworts in the epiphytic habitat, and lichens did not share patterns with any other group. Beta diversity of all studied plant groups (lichens not included due to low species richness) was similar in the terrestrial habitat, but not in the epiphytic habitat. Our results demonstrate that patterns of alpha diversity of the four plant groups can not be used to predict patterns of beta diversity. Moreover diversity patterns observed in cryptogamic epiphytes are not the same as in terrestrial ones. We hypothesize that diversity and distribution patterns of cryptogamic taxa are mostly determined by the moisture requirements of the plants in their gametophyte life stage, with mosses apparently being most dependent on high water supply, ferns and liverworts being intermediate, and lichens nearly indifferent to water availability.

11-00 Coffee Break

11:20 Tropical tree barcoding, a case study in french guiana

Gonzalez Mailyn Adriana; Chave Jerome; Vicedo Celine; Thebaud Christophe
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Understanding the structure of biodiversity is crucial for its conservation. Unfortunately, tropical plant species diversity remains underestimated, mostly because of the tremendous challenge posed by their reliable identification. Indeed leaves and reproductive organs are usually not available in the field. A partial solution to this problem would be to implement molecular identification tools, also known as ƒ?~DNA barcodesƒ?T. This method uses one or several small DNA sequences that facilitate the discrimination among species. For instance, CoxI, a mitochondrial sequence, is already widely used as a barcode for animals.
So far, several candidate barcodes have been proposed for plants but a consensus has not yet emerged. We have tested two chloroplastic coding sequences, rpoC1 and rpoB, for their potential use as barcodes in two 0.5 ha plots of a tropical tree community in

French Guiana. Preliminary results show that these sequences allow the correct assignment of trees at least to the genus level. This first taxonomical identification is an important step forward in the understanding of tropical trees communities, and it should prove highly valuable for the study of biodiversity in the tropics. In this contribution, we will also discuss the potential problems posed by the use of barcodes in tropical plant diversity surveys.

11:40 Tree species diversity in Yunnan Province, SW China

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Yunnan Province is located in the southwest of China, bordering with Myanmar, Laos, and Vietnam in the west and the south. It includes tropical rain forest, subtropical evergreen broad-leaved forest and sub-alpine coniferous forest. This province harbors about 1/2 of vascular plants in China, playing an important role in the biodiversity conservation of China. The present report summarizes the tress species diversity patterns in the three forest types of different climatic zones. The results show that the values of Shannon-Wiener Index for tree species diversity decline with the increase in latitude and altitude, corresponding with the temperature gradient from the south to the north. Human induced disturbance, however, reduces the tree species diversity of the forests. Our study suggests that the tree species diversity index of the secondary forests tends to vary in different patterns within the three forest types.

12:00 Achieving Target 2 of the Global Strategy for Plant Conservation: Building a Preliminary Assessment of Vascular Plant Species Using Data from Herbarium Specimens

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The Global Strategy for Plant Conservation calls for a preliminary assessment of the conservation status of all known plant species by the year 2010. To date insufficient progress has been made on meeting this target. New efforts to develop a preliminary list beyond full, "gold standard" plant assessments are needed. Here we present an algorithm that provides a preliminary assessment of the conservation status of plant species using data from herbarium specimens. We use Hawaiian specimen data from the United States National Herbarium to determine the parameters of the algorithm and then use specimen data from the Heliconiaceae and Gesneriaceae for trials of the algorithm. The algorithm was 95% accurate in placing Hawaiian endangered plant species, whose conservation status have previously been assessed, into the appropriate threatened categories. About one third of the Hawaiian taxa, one third of the species of Heliconiaceae, and one quarter of the species of Gesneriaceae were identified as Not Threatened and will not need any further evaluation. Species identified here as Potentially Extinct and Potentially Threatened can be further assessed by additional herbarium material and/or conservation specialists for final evaluation using other assessment strategies (e.g., regional and national lists, taxonomic expert assessment,

etc.).

Ecology and Conservation of Mammals. Part I

Room 8: Enrique Shuls (Second Floor)
Building: Colegio Primitivo de San Nicolás de Hidalgo
Tuesday July 17

10:00 Breeding behavior of Leptonycteris yerbabuenae (Phyllostomidae: Glossophaginae): Female choice or male power?
Sotner Kathryn E.; Henry Micka¦«l; Quesada Mauricio; Avila Cabadilla Luis Daniel; Chaves Oscar M.; Nassar Jafet M.
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Information on mating systems exists for only 66 of the 1100 bat species known. Similar to other mammals most of them are polygynous. Multi-male multi-female groups have been reported for only 16 species. We observed copulations of Leptonycteris yerbabuenae in a cave housing approximately 30,000 individuals on Isla Don Panchito, Jalisco, Mexico. Reproductive males were found in a lek-type organization away from the main roosting group. Agonist interactions were frequently observed between reproductive males that defended small roosting territories around them allowing space for females to land. Males repeatedly licked their back foot and then scratched their genital area, finally transferring genital secretions to the middle of their back by scratching the interscapular zone with their foot. This process resulted in a strongly scented dorsal patch. Females repeatedly hovered in front of males often flying up to ƒ?oevaluateƒ?? and touch the dorsal patch with their nose. Upon selecting a male, females placed their ventral surface against the malesï back and hung from the back of the male caressing the dorsal patch. Two types of copulatory behavior were observed. In-pair mating occurred when a male initiated copulation with a female that was hanging on his back. When completed the female remained with the male returning to his back. Extra-pair copulations occurred when males grabbed nearby females and forced copulation. This behaviour was not preceded by any physical contact between the two individuals and the female departed immediately after copulation. The proportion of forced copulations observed in L. yerbabuenae (69.9 ‹'ñ 5.1%) represents the first documented case of recurrent forced copulations in mammals. In this species, sexual coercion appears to be more important than female choice, but genetic paternity studies are needed to further evaluate this hypothesis.

10:20 Density of Primates in the Central Amazonian Terra Firme Forests
Spironello Wilson; Rodrigues Liliam; Rosas-Ribeiro Patricia
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In this study we present data on the species composition, population density and biomass of primates in three terra firme forest areas north of Manaus. The data were collected in 2005 and 2006 using line transect methodology. Two 1-km2 plot (six transects in each one) were surveyed at each study area: Adolpho Ducke Reserve (ADR); Large Scale Biosphere-Atmosphere Experiment in Amazonia (LBA); and Biological Dinamic of Forest Fragment Project (BDFFP). In each year two wet/dry season months were sampled, giving an all-site total of 1152 km walked over the sample period. Group densities were calculated using the program Distance 5.0 for species with more than 30 sightings. For those with less, the effective strip width (ESW) distance was calculated using an pooled analysis of the perpendicular distance obtained at the three areas. Seven species were recorded: Ateles paniscus, Alouatta seniculus, Cebus apella, Chiropotes sagulatus, Pithecia pithecia, Saguinus midas and Saguinus bicolor. When we calculated a combined density for the three areas Alouatta presented the highest density (2 grp.km-2) and biomass (70 kg.km-2), while Ateles presented the smallest density (0.23) and S. bicolor the smallest biomass (2.5). Ducke Reserve had the lowest density for Ateles (0.04), probably because of the proximity of Manaus, which provided greater human pressure at this area. Variations also occurred in the density of Cebus and Alouatta, which are probably related to inter-site differences. When we compared the species densities with other studies in the region, we also noted some differences, especially for Pithecia and Chiropotes, which densities may have been overestimated in this study. These variations may be explained in the following ways: sample design and variability of field methods and data analysis, e.g. differences in calculating ESW. In conclusion methodological standardization is essential for effective comparison of the primate communities of different areas and regions.

10:40 Explaining patterns of group decline and infant mortality in a Panamanian population of mantled howler monkeys

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Over 60% of primate species are threatened, and many of these species are group-living with complex social structures. Evidence of differential group success in declining populations of primates highlights the need for more studies that can quantitatively link varying patterns of survivorship between established social groups to specific explanatory factors. This research investigates patterns of survivorship in eight groups of mantled howler monkeys (Alouatta palliata) totaling 164 initial individuals over the course of 14-months in a protected area in Panama. During this time period, this population subset experienced an overall 10% decline. However, losses among social groups were not homogenous. Four of the 8 groups lost between 29- 48% of all group members and experienced infant mortality rates of up to 100%. Resource availability, group demographics, behavior, inter-specific competition, and disease were considered as possible explanatory factors for differential group success. Results indicate that the prevalence and intensity of infection by a host-specific bot fly parasite and behavioral factors, especially inter- and intra-group patterns of aggression, were most significantly correlated with both infant mortality and group decline. These results stress the importance of considering both disease and behavior when predicting changes to population structure in declining populations of highly social group-living organisms such as primates.

11-00 Coffee Break

11:20 Niche Divergence of Two Species of New World Primates: White-faced and Bearded Sakis in Suriname

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Abstract
Bearded sakis (Chiropotes sagulatus) and white-faced sakis (Pithecia pithecia) share dental specializations that set them apart from other platyrrhines, but they are considerably different behaviorally. We conducted a comparative analysis of feeding ecology, ranging patterns, and social cohesion during a 10-week study from May to August 2005 and a six-week study from May to July, 2006 at Brownsberg Nature Park, Suriname. Using 10-minute scans, we found that bearded sakis used higher forest levels and larger feeding trees, and had faster travel rates and different activity patterns. Bearded sakis formed larger, more dispersed multi-male groups compared with white-faced saki single-male groups. Despite dental adaptations for seed predation, there was only 19.0% and 15.8% overlap in the 2005 and 2006 study periods respectively in feeding species ingested. While diet and morphology related to seed predation characterize both species, segregation along several behavioral and ecological niche axes may minimize competition. We suggest that socially, within the pitheciin clade, white-faced sakis represent an intermediate between monogamous titi monkeys and multimale-multifemale bearded sakis and uakaris. With regards to bearded saki social organization, we suggest that male phylopatry and collegiality facilitate cooperative multimale groups. Covert forms of male-male competition such as sperm competition may also improve the ability of bearded sakis to live in multimale-multifemale groups without being highly sexually dimorphic.

11:40 Why didn't the bandicoot cross the road?

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Roads form barriers to the movement of some animals. This can prevent gene flow between sub-populations, restrict the area available for foraging and disrupt annual migration patterns. But why are roads barriers? Some factors are well described in the literature and include the width of the road, traffic volume (including mortality) and canopy cover over the road. Other contributing factors, however, are yet to be examined. One of these is traffic noise. What role does it play in the barrier effect of roads? This study looked at the effects of roads and traffic noise on the movement of four species of medium-sized, ground-dwelling rainforest mammals in the Wet Tropics World Heritage Area in Queensland, Australia. Target species represented a variety of tolerance to disturbance and included the giant white-tailed rat (Uromys caudimaculatus), long-nosed bandicoot (Perameles nasuta), northern brown bandicoot (Isoodon macrourus) and

musky rat-kangaroo (Hypsiprymnodon moschatus). Representatives from the four species were spool-and-line tracked to determine changes to their movement patterns while traffic noise was played through speakers at 70dB(A), the mean level measured adjacent to Wet Tropics highways carrying approximately 8,000 vehicles/day. Results suggest that traffic noise by itself is not affecting everyday movements, crossing rates or path tortuosity. Potential reasons for this and other factors that affect movement in relation to roads will be discussed.

12:00 Ecology of the water opossum, Chironectes minimus, in Atlantic Forest streams in southeastern Brazil

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The water opossum Chironectes minimus is the World*ƒ*?Ts only semiaquatic marsupial. As it is seldom captured with usual methods, there has been no previous study on its ecology. With the goal of studying the demography and spatial patterns of C. minimus, capture-mark-recapture and radiotelemetry studies have been carried out in streams of the Sao Joao River Basin, southeast Brazil, from October 2004 to March 2007. A new method, allowing water to flow through double door Tomahawk traps, baited with shrimp or fish, was successful in capturing the animal. Individuals were marked with ear tags; adults were fitted with radiotransmitters. Night-time locations were obtained by *ƒ*?ohoming in on the animal*ƒ*?? method. Locations were plotted on the streams*ƒ*?T course, using GPS and ArcView 3.2. There were 62 captures of 21 males (52 captures) and 4 females (10 captures). Sex ratio was biased towards males (chi-square=10.24, p<0.01). All captured males were scrotal; however, breeding females were captured only in August 2005, September 2005 and 2006 and March 2007. Young individuals were captured throughout the study. Four males and two females were radiotracked. All locations were obtained within 2 m of rivers, but two individuals traversed about 100 m across land. The stretches of river used varied from 844 to 3,724 m, males using lengths thrice those of females. Stretches used overlapped with the opposite sex (males: 26.6+/-12.6%; females: 46.4+/-2.6%) and among males (47.0+/-27.5%). Animals used areas with stony substratum, flowing water and riparian vegetation. The great length of riverine habitat needed for each C. minimus and the anthropic pressures on its habitat are rather threatening for the species. This study emphasized the importance of protecting rivers with flowing waters and stony substratum for conserving the water opossum. Support: Critical Ecosystems Partnership Fund, FundaCao Boticario de ProteCao a Natureza, CNPq, Golden Lion Tamarin Association.

Social and Economic Drivers of Change of Tropical Ecosystems. Part I

Room 9: Aristóteles (Second Floor)
Building: Colegio Primitivo de San Nicolás de Hidalgo
Tuesday July 17

10:00 Local causes of deforestation in the Kalakad-Mundanthurai Tiger Reserve in the southern Western Ghats, India
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We studied the local causes of deforestation in the dry forests in Kalakad-Mundanthurai Tiger Reserve (KMTR), Western Ghats, India, from 1998 to 2002. We estimated the quantity of non-timber forest products (NTFP) collected from the forest by 786 households from 31 villages located adjacent to the reserve and assessed the impact on forest vegetation. About 43% of the 786 households surveyed collected forest products such as fuel-wood, fodder and green leaves. About 80% of the quantity collected contributed to household consumption and 20% to household earnings. Low income (LI) households collected and sold fuel-wood to earn a living, whereas wealthier agricultural (WA) households collected solely for household consumption. Per capita extraction was higher among the LI households, whereas WA households collectively extracted more resources from the forest. The forest adjoining the villages showed lower stem densities, basal area and poorer regeneration compared with sites with no human impact, suggesting that resource collection was not sustainable. We conclude that household energy needs, agricultural intensification, availability of low cost wage labor and livelihood concerns were the drivers of deforestation in the buffer zone of KMTR.

10:20 Land-Use Change in Bolivia: Who, Where, When, and How Much
KIlleen Timothy
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Symposium: The influence of human demography and agriculture on natural systems in the Neotropics*ƒ*??

The history of land-use change and migration in eastern Bolivia is documented from the onset of colonization phenomena in the late 1950s to the present. The study is based on land cover in 1976 and land-use change for four sequential epochs: 1976 *ƒ*?" 1986, 1986 *ƒ*?" 1991, 1991 *ƒ*?" 2001 and 2001 *ƒ*?" 2004. The study includes landscapes situated below the montane tree line (~3000 m), including forest, savanna, scrubland, water, and seasonal wetlands.. Rates of land use change have grown from approximately 45,000 ha yr-1 in the 1960s to more than 290,000 ha yr-1 in the last epoch. Land-use change was quantified for ten distinct social actors, each with shared cultural traditions and a common production system. Traditional mechanized farmers from Santa Cruz and

Andean colonists were responsible for most land-use change in the 1960s and 70s (19,177 and 7,919 ha yr-1 respectively), the rate of deforestation for Andean colonists grew the late 70s and 80s (41,832 ha yr-1). Andean colonists experienced a brief decline in the 90s (29,917 ha yr-1), but rates increased again in the most recent epoch due to landless peasant groups occupying lands on the edge of the agricultural frontier (61,663 ha yr-1). Japanese colonists have shown low but constant rates of land-use change over four decades (2500 ƒ?" 3880 ha yr-1), while Mennonite colonies have experienced a steady increase in land-use change that tracks migration into the country (1094 to 16,550 ha yr-1). In the last 15 years, land-use change by ago-industrialists specializing in soy and other oil crops (49,536 ha yr-1) and cattle ranching based on cultivated pastures (~ 70,000 ha yr-1) surpassed all other groups and are approaching exponential rates of growth in annual rates of land-use change.

10:40 The Challenge of cattle ranching to common property and Chacoan dry forest in the Isoso, Bolivia

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The Isosenos live along the Parapeti River in the eastern lowlands of Bolivia. Like many other indigenous groups in Latin America, they share a common property territory and their main organizational structures are well developed. These structures, particularly the communal asambleas and the strong inter-institutional links between CABI and the external world, have allowed them to adapt and incorporate their economic strategies but still maintain their Nandereko (the Guarani way of life) and the Mbayu (vision as People).
Cattle ranching is the principal productive activity in the area and it is also the main ecological concern because it leads to overgrazing. The goal of this research was to understand the forces contributing to the expansion of cattle ranching in the Isoso as well as their effects on the Guarani Isosenoƒ?Ts common property institutions and natural resources. I examined the Guarani-Isoseno institutions based on their Mbayu vision within the Common Property and Community Based Management frameworks. I employed individual and group interviews to gather data and participated in several community meetings.
Certain communities are taking specific decisions to regulate the presence and impact of cattle. Cattle-raising will continue to play a part in the Isoso because it complements the livelihood of the communities, providing protein and income. Cattle ranching can also contribute to socioeconomic development, and, if the management is sustainable, it could support a biodiversity conservation strategy in the TCO -Isoso. In contrast to industrial agriculture with its concomitant deforestation, cattle-ranching can be a less threatening activity, and for this reason it is included as a central element in the CABI and Isosenoƒ?Ts development strategy.

11-00 Coffee Break

11:20 Transformation Ecosystems Analysis in the Colombian Andes Region

Bernal Nestor; Rincon Alexander; Rodriguez Nelly; Franco Carol

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Colombia integrates the tropical Andes region considered by Myers (1988) as one of terrestrial ecoregions with priority in the global context. Together with Venezuela, Per£, Ecuador and Bolivia, they contribute to 23% (287.720 km2) of the total Andes region. They exhibit a complex mosaic of ecosystems generated by climatic diversity, geology, geomorfology and soils (Rodr¡guez et al., 2006). As complements of these natural conditions, the Colombian Andes region is an important region; in 2005, it had a high concentration of human population (77,4% of the total population in Colombia). This region is an economic center in Colombia too, it represented 87% of total Colombian economic activity in 2003.
In line with this framework, the main objective analyzed by this paper is the relationship ƒ?" linking transformation ecosystems for 2000, with demographic, economic and social drivers. This paper ilustrates the analysis for 26 regional environmental authorities called, ƒ?oCorporaciones Aut¢nomas Regional y de Desarrollo Sostenibleƒ?? (CARs), and uses municipality information associated with each CAR. Analysis involves indicators related to population density, economic activity, quality of life index, net forced movement, deficit water index, environmental investment and changes in ecosystems area. Methods used in order to achieve the goal mentioned above were: principal components analysis, hierarchical cluster analysis and exploratory spatial data analysis (S nchez, 2006).
The results show how in the Colombian Andes Region there are several spatial zones (realities) influenced by diverse transformation processes of ecosystems. They also show how some drivers have relationships with ecosystem transformation. These results are useful to regional environmental authorities in order to plan and make decisions related to ecosystem conservation strategies.

11:40 The Ecological Crisis in Chiapas (southern Mexico) â?" a Central American Dilemma

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During the last 40 years most landscapes in Chiapas were subjected to dramatic changes in land use that has caused various problems in an ecological highland-lowland interactive system. In the Soconusco coastal plain, cash crops with long dry fallow periods generated a decline in regional precipitation. In the lower escarpment of the Sierra Madre, coffee plantations with unshaded cultivations in rows and input of herbicides reinforced major hydrological fluctuations. While these impacts have been reduced during the last decade, demographic pressure in the upper part of the Sierra Madre and in the Altos de Chiapas still continues, resulting in a growing need for land, is responsible for advancement of the frontier of indigenous settlement into steeper parts of the Sierra itself and towards Lacandonia. The resulting soil erosion and soil leaching cause further degradation, and, together with elevated runoff rates, also have a heavy impact on the forelands. This was evident in Sept. 1998 and Oct. 2005 in the form of disastrous floods and devastation in the Soconusco plain. - Many areas in Chiapas have

been investigated by German geographers since 1920 (Waibel in the 1920s, Helbig in the 1950s, the author since 1980). Thus, a unique groundwork for a long-term derivation of social as well as economical change and its effects on tropical ecosystems and their interactive relations exists (hydrology, mass movement and erosion, regional climate change, loss of nature-near ecosystems, weed infestation). The presentation ends with some ideas on ƒ?opolitical ecologyƒ?? as an approach in addressing the responsibility of environmental agents.

12:00 Is polewood too complex for sustainability? An interdisciplinary analysis of the commercialization of small diameter tropical trees in Quintana Roo, Mexico

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In an effort to combine ecological and social dimensions of environmental research into one interdisciplinary analytical framework, I examine the case of the commercialization of small diameter tropical trees (5-35 cm dbh) as polewood from common property forests of central Quintana Roo, Mexico. Maya communities have responded to a rapid rise in demand for polewood as construction material by harvesting these trees from community forests and selling them through a series of intermediaries. I combine research from ecological studies with preliminary results from surveys conducted in 12 local communities to illustrate conflicting views of harvesting effects. Ecological studies illustrate the drastic impacts of polewood harvesting on forest structure. Although many respondents confirm these ecological impacts and the impacts on local supply, most of those directly involved in polewood sales believe there is no ecological effect of a commercial harvest and say they will continue to sell. On the other hand, although many respondents report that despite the potential income from the sale of polewood, there exists an inequitable distribution of benefits. These results suggest that the rapid development of the commercial polewood market has in effect evaded existing local management institutions. Interviews with land managers and state-level forestry officials disclose that given the silvicultural properties of these trees and the existing management framework, the sustainable management of these forest resources is extremely challenging. An adaptive collaborative management approach, although required, is difficult given the different values and perceptions of each actor. This paper analyzes these social-ecological dynamics with the purpose to contribute to a better understanding of the complexity of social-ecological systems in a common property framework.

Ethonobiology

Room 10: Manuel Altamirano (Second Floor)
Building: Colegio Primitivo de San Nicolás de Hidalgo
Tuesday July 17

10:00 A collaborative research process for studying fruit availability and seed dispersal within an indigenous community of the Middle Caqueta river region, Colombian Amazonia
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It is presented a collaborative research process between the Nonuya indigenous community and western scientists while studying fruit production patterns and the role of animals in the spatial distribution patterns of terra firme rain forest tree species in Colombian Amazonia. The process is presented in four stages, initially with a distant relationship between western scientists and indigenous people with little exchange of knowledge progressing to a collaborative research relationship of high knowledge exchange. The first stage consisted of the participation of indigenous people within an exclusively scientific research on natural sciences passive fieldwork guides. The second stage occurred when the guide became a fieldwork assistant and received training and expertise in scientific methodologies for data collection. The relationship between western scientists and indigenous people develops into frequent debates and discussions over observations, findings and interpretations. In the third stage, the indigenous fieldwork assistant proposed his ƒ?oown researchƒ?? where he combined both scientific methodologies and dialogue with elders for obtaining information. During the fourth stage of the process, information of high quality and relevance to the needs of both western-scientists and indigenous people was generated. This collaborative research process allowed the exchange of experiences, methodologies and learning, and has led to a better understanding of tropical rainforests. The implications of this experience for future research with indigenous communities are discussed.

10:20 Ancient Tea Garden within Natural Forest-A World Heritage Agro-ecosystem in Southern Yunnan, China
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As one of the three most popular beverages, tea production has been increasing during the past three centuries. Yunnan has the largest area of tea plantation in China, but the income from tea industry just ranked as third. Tea plantation are conventionally established on deforested area under full sun and with high dose application of fertilizer and pesticides, whereas the recently discovered-old tea plantations in Yunnan of China

are covered by forest canopy and self-sustained in production and pest control. While maintaining high annual tea production, the shaded-tea plantations preserve rich species of woody plants, shrubs, herbs, grasses, ferns and mosses. Bird visit was also much higher in ancient than the conventional tea plantations. Shaded-tea plantation can be an alternative to the conventional sun-tea plantations to preserve biological diversity and develop sustainable agro-ecosystems.
Due to the rising price of Puer Tea recent years, ancient tea gardens/trees are facing more pressure. In the case study we discussed ancient tea garden use and biological conservation both in technique and policy aspects.

10:40 Applying indigenous knowledge to the restoration of degraded tropical rain forest dominated by bracken.
Douterlungne David; Levy Israel Tacher Samuel; Golicher Duncan; Roman Danobeytia Francisco
ECOSUR; ECOSUR; ECOSUR; ECOSUR
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The indigenous inhabitants of the Lacandon forest of southern Mexico have traditionally used a long fallow rotational slash and burn system for maize production. Although successional processes usually rapidly restores abandoned fields, the invasive fern Pteridium aquilinium (bracken) can dominate areas that have been overused, thus preventing nutrient accumulation in the fallow period. The Lacandon are aware of this effect and claim that the fast growing tree Ochroma pyramidale (balsa) can restore areas degraded by bracken dominance. Balsa potentially could accelerate succession towards mature forest and increase the rate at which organic matter and nutrients accumulate in the soil. Here we provide experimental evidence that supports the Lacandonƒ?Ts knowledge of the properties of these species and shows the effectiveness of their traditional low input restoration techniques.
We found that sowing balsa by simple broadcasting its seeds in plots previously dominated by bracken resulted in effective establishment when combined with traditional weeding techniques. Balsa established in this way initially increased in height at a more or less constant rate of 63 cm (ñ7 cm) per month. After twelve months growth experimental plots had top heights of over 6m and basal areas of 4.1 (+-0.3) m2 ha-1. We contrasted this low cost traditional fallow management technique with direct sowing and transplanting of balsa. Although direct sowing was slightly more effective our results validate the effectiveness of the Lacandon method of directing succession.

11-00 Coffee Break

11:20 Quantitative ethnoecology as a tool for biodiversity conservation in silvopastoral systems of Nicaragua
Ramirez Leornardo R; Casanoves Fernando; Harvey Celia A; De Clerck Fabricie
CATIE; CATIE; Conservation International; CATIE
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Silvopastoral systems are socio-ecological systems that influence biodiversity

conservation at farm and landscape levels. Nevertheless, no known ethnoecological research has been conducted in silvopastoral landscapes, nor are there any known data on how local producers take into consideration ecological knowledge when making decisions on the design and management of their farms. The aims of the study were to: (i) record cattle farmer*ƒ*?Ts ecological knowledge in relation to biological conservation in Matigu s, Nicaragua and (ii) analyze the applicability of the local ecological knowledge as a tool for conservation planning at landscape scales. To complete these objectives, we interviewed farmers that have incorporated silvopastoral systems on their farms. We treated farmer answers were as categorical variables and analyzed them with frequency tables. Our results indicate that the farmers have a significant local ecological knowledge base that is the product of accumulated experiences and of social ties established within the community. Farmers frequently mentioned the importance of conserving biodiversity and indicated that riparian forests have a high conservation value. Farmers recognized that the tree component of live fences and of dispersed trees in the pastures fostered positive interactions with local avifauna. Many of the farmer*ƒ*?Ts responses on the conservation value of different landscape features were in agreement with biodiversity inventories previously conducted in this same landscape. Our study demonstrates that quantitative ethnoecology is an important tool for generating regional conservation strategies that are locally accepted, and scientifically rigorous.

11:40 Traditional knowledge as a basis for planning conservation at the Uacari Sustainable Development Reserve, Amazon, Brazil

Marinelli Carlos Eduardo; F. Batista Romulo; S. Valente Rafael; P. Kasecker Thais
Secretaria de Estado do Meio Ambiente e Desenvolvimento Sustentavel do Amazonas (SDS); Secretaria de Estado do Meio Ambiente e Desenvolvimento Sustentavel do Amazonas (SDS); Secretaria de Estado do Meio Ambiente e Desenvolvimento Sustentavel do Amazonas (SD
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The Uacari Sustainable Development Reserve (USDR), with its 660,000 ha, in the state of Amazonas (Brazil), is a reserve located in one of the most pristine portions of tropical forest inside the Amazon Basin. Among the major features that can be used to describe the reserve we can find the high level of integrity of its biodiversity, fortified by the strong level of cooperation of the local communities to build strategies to conserve the local environment. Following the way of life typically found in traditional communities inhabiting preserved areas of flooded forests in the Amazon region, the subsistence of 1300 people residing the USDR is strictly dependent on the exploitation of animal and plant resources, activities directly connected to their empirical knowledge regarding composition, distribution, potentialities and fragilities to exploit those natural resources. During two years the SDS technical staff gathered information about 31 mammalian species, 31 species of fish, 20 species of fish, 8 species of reptiles, 6 species of vines, 12 species of palm tress and 36 species of timber trees exploited inside the reserve. This information was collected using interviews, involvement activities, and meetings with social leaders and training courses. Once the information was obtained it was arranged, spatialized using GIS and, later, complemented with the technical knowledge used to elaborate the first reserve*ƒ*?Ts zoning proposal. The major objective of those products is to provide a basis for the construction and discussion of strategies and researching actions, monitoring, public use, education, management and protection of the reserve, that will be later included in the Management Plan.

12:00 Community Landscape Planning for Rural Areas: A Model for Biocultural Resource Management

del Amo Silvia; Vergara-Tenorio Maria del Carmen; Ramos Prado Jose Maria; Porter Bolland Luciana
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In this paper we discuss a model for resource management in the tropics that includes biological and cultural aspects which we have called ƒ?oBiocultural Resource Management modelƒ??. The model can be used as a strategy for co-responsible landscape planning that could be implemented in rural areas having the local populations as the engines for conservation, restoration, and management of natural resources. The model was born from a ten-year working experience in Mexico through a NGO called Programa de Accion Forestal Tropical, (PROAFT). The model takes into account the failures and successes derived from PROAFTƒ?Ts developing projects in community landscape planning, in different ethnic communities at the Southeast of Mexico. Our model comprises different units of production, and management-conservation levels. The model uses a diversity of native species for management and conservation. It is structured in four levels accommodated in concentric circles that have a gradient of land use intensity. In general terms, the circular representation has spatial, temporal and cultural meanings. As the rings spread farther away, more space is needed for agroecosystems productive activities. A fundamental component that derived to the modelƒ?Ts design was the understanding of traditional management practices of different ethnic communities throughout Mexico.

Pollination and plant reproduction. Part I

Room 6: Sala 2 (Second Floor)
Building: Centro Cultural Universitario
Tuesday July 17

14:00 An account of vivipary in the cactus family
Cota-Sanchez Hugo; Deise Deusa; Reyes-Olivas Alvaro; Sanchez-Soto Bardo
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The wide array of floral shapes and breeding systems in the Cactaceae has contributed to the family*ƒ*?Ts genetic diversity and diversification. Out of ca. 1,100 species of cacti, the reproductive biology has been investigated in < 10% of taxa. Vivipary, a phenomenon characterized by the lack of dormancy with subsequent germination of seeds within the fruit before they are shed from the parent plant, is a notorious event in the Cactaceae. Here we summarize its taxonomic occurrence in the family, which is restricted to six tribes of the subfamily Cactoideae (Cacteae, Cereeae, Hylocereeae, Pachycereeaae, Rhipsalideae, Trichocereeae) and discuss its incidence in cultivated and wild taxa distributed in marine flooding and non-flooding environments, and tropical forests. Overall, viviparous offspring exhibit normal development, but the seedlings exhibit differences in size and organ differentiation. In the Cactaceae vivipary is interpreted as a specialized trait of evolutionary and biological significance providing new avenues for dispersal and species perpetuation. To test this idea, we conducted experimental tests to evaluate the establishment of viviparous offspring of Epiphylllum phyllanthus in different substrates and areas of the phorophyte. Preliminary data indicate that early seedling establishment is critical during the first days in all trials. Seedling survival is more effective in controlled conditions of photoperiod and temperature followed by ground substrate near the phorophyte and finally on the phorophyte surface. Larger seedlings with developed cotyledons/roots are fitter and able to establish sooner compared to recently germinated seedlings. Both conspecific and hetereospecific post-germination nursing is involved in this event, but successful seedling dispersal depends on landing on optimal microhabitat conditions for establishment. Vivipary, a costly reproductive strategy, provides fitness advantages to perpetuate the species. It is an independent, convergent trait occurring in phylogenetically distant lineages of the Cactoideae, including epiphytic and terrestrial lineages distributed in environmentally stressed conditions.

14:20 Incidence of floral herbivory and the variation of reproductive performance of Eriotheca gracilipes (Bombacaceae) in two Brazilian savanna physiognomies
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A growing number of studies recognize that floral herbivory is common in natural systems

and can affect male and female plant fitness. The amount of floral herbivory and subsequent fruit set of the tree Eriotheca gracilipes (Bombacaceae) was surveyed from June to September in two Brazilian savanna physiognomies (cerrado and campo cerrado) in Sao Paulo state. The flowers of E. gracilipes are visited by insects including Centris spp., Xylocopa sp., Halictidae, Trigona spinipes (Apidae), non-native honeybees (Apis mellifera) and hummingbirds (Chlorostilbon aureoventris and Eupetomena macroura). The number of floral buds produced per plant did not differ between physiognomies, but the number of flowers and fruits were higher in cerrado than in campo cerrado. Apparently, bud and flower survival rate differed between physiognomies, being higher in cerrado. Each tagged bud or flower was recorded as having one of four different damage types: eaten by Trigona spinipes, Aphid presence, floral bud oviposition, dry buds. The combination of two or more damage types can also be found. Most damage was caused by Trigona spinipes in cerrado and by bud oviposition in campo cerrado. The incidence of damage differed significantly among damage types and there was interaction between damage type and physiognomy, suggesting that the incidence of total damage is dependent upon physiognomy and damage type. Considering only kind of damages made by Trigona spinipes, whether they were superficial, affected all the reproductive structure or only androecium or gynoecium, superficial damages were the more frequent ones in cerrado, while total damages were the more frequent in campo cerrado. From the 360 tagged buds in cerrado, we registered a total of 25 fruits, while in campo cerrado no fruits were recorded. The contrasts on the kind and incidence of floral herbivory constrained the reproductive performance of E. gracilipes between physiognomy differently (Grant from CNPq 141472/2003-0).

14:40 Evolution of pollination systems in Ruellia (Acanthaceae)

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The genus Ruellia (Acanthaceae) contains approximately 300 species, is largely herbaceous, and is primarily tropical or subtropical in distribution. Species of Ruellia are extraordinarily diverse in floral morphology. This floral diversity has led authors to predict that pollinators have had an important role in the overall speciation of the genus. Molecular phylogenetic analyses of 116 species of Ruellia were conducted to reconstruct the evolution of pollination systems, floral traits, and plant habit. While ancestral character states of deep nodes are equivocal, bee, hummingbird, hawkmoth, and bat pollination have all evolved multiple times. Further, there is compelling evidence for multiple transitions from hummingbird to bee pollination. This result is striking because it is anomalous in floral evolution, and challenges the dogma that specialized states are evolutionary dead-ends. Finally, both liana and treelet habits have evolved multiple times, and tests for character correlation suggest bat pollination is significantly more likely to evolve given liana or treelet habit as well as more likely to evolve in plants with terminal inflorescences. Thus, bat pollination may evolve as a consequence of more aerial flower production. The ability of species of Ruellia to exploit a wide range of pollinator niches and reproductive strategies probably helps explain the diversity and widespread distribution of the genus.

15:00 Coffee Break

15:20 Do dioecious species have larger seeds than cosexual or monoecious species?: Cross-species and phylogenetic analyses among neotropical rainforest species of SE Peru

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Females of dioecious species are predicted to produce larger or more seeds than hermaphrotic individuals because: (1) pure females allocate no resources to male function and (2) pure females must have higher reproductive success than their hermaphroditic counterparts to achieve the same per capita population growth rate (given equal adult population densities). To test this prediction for seed size, we examined the relationship between seed size, life form, and breeding system among hundreds of plant species of the Tambopata Wildlife Reserve in southeastern Peru. Cross-species analyses (pooling all life forms) indicate that dioecious species (N = 201) produce significantly larger seeds than perfect-flowered (N = 629) or monoecious species (N = 99); and trees (N = 475) and lianas (N = 125) produce significantly larger seeds than shrubs (N = 165), vines (N = 65), and herbs (N = 76). Within life forms, dioecious species produce significantly larger seeds than hermaphroditic and/or monoecious species in lianas and shrubs, but not in trees or vines. Among herbs, monoecious species produce significantly larger seeds than perfect-flowered species. We conducted phylogenetically independent contrasts (PICS) to determine whether evolutionary transitions in breeding system are associated with changes in seed size within and across life forms. Pooling life forms, dioecious clades have larger seeds than their nondioecious sister clades; these patterns were not significant based on sign tests, but the difference in seed size between these two groups was significantly greater than zero (the dioecious clade being larger-seeded). Among woody taxa, PICS detected weak evidence that breeding system and seed size are associated (sign tests detected no pattern, while the contrasts in seed size between dioecious taxa and cosexual or monoecious taxa were significantly greater than zero). Within other life forms, PICS detected no association between breeding system and seed size.

15:40 Pollinator attraction and intersexual mimicry in dioecious fig species

Martine Hossaert-McKey; Jean-Marie Bessi¦•re; Magali Proffit; Catherine Soler; Renée M. Borges; Chen Chun
Centre d'Ecologie Fonctionnelle et Evolutive (CEFE, CNRS) 1919 route de Mende 34293 Montpellier Cedex 5, France; Centre d'Ecologie Fonctionnelle et Evolutive (CEFE, CNRS) 1919 route de Mende 34293 Montpellier Cedex 5, France; Centre d'Ecologie Fonctionnelle et Evolutive (CEFE, CNRS) 1919 route de Mende 34293 Montpellier Cedex 5, France; Centre d'Ecologie Fonctionnelle et Evolutive (CEFE, CNRS) 1919 route de Mende 34293 Montpellier Cedex 5, France; Centre for Ecological Sciences Indian Institute of Science, Bangalore 560012, India; Xishuangbanna Tropical Botanical Garden, The Chinese Academy of Sciences, Kunming, China
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Chemical mediation*ƒ*?"olfactory attraction of pollinators to volatile compounds released by receptive figs*ƒ*?"is important in ensuring the encounter between figs and their species-specific pollinating wasps. However, pollinator attraction in dioecious figs presents particular problems, and the chemical ecology of wasp/fig interactions in dioecious

figs*ƒ*?"half of all fig species*ƒ*?"is still poorly understood. Pollination in dioecious figs requires that pollinating wasps enter female figs in which they die without laying eggs. Mechanisms for the evolutionary stability of dioecious fig/pollinator mutualisms are still unclear. One very appealing hypothesis holds that in dioecious figs, individuals of each sex are selected to produce odours that are difficult for wasps to distinguish from those produced by the other sex. We used headspace adsorption/resorption methods to collect odours of several dioecious fig species in tropical forests of India, Brunei and China, and analyzed the composition of their volatile compounds using gas chromatography/mass spectrometry (GC-MS). Our results showed that in fig species in which male and female receptive figs are present simultaneously (e.g., F. hispida), variation in odour composition among individuals of the same sex was much greater than variation between sexes, explaining the failure of wasps, in choice experiments, to discriminate between figs of the two sexes. In contrast, in fig species such as F. exasperata where male and female receptive figs are rarely found simultaneously (low-intensity flowering by males during the female season permits closure of the cycle), odours of male and female figs were more distinct.

16:00 Community structure of fig wasps in Ficus benjamina

Bai Lifen; Yang Darong
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The mutualism between fig trees (Ficus spp.) and their species-specific fig wasp pollinators (Hymenoptera: Chalcidoidea: Agaonidae) is well known, but numerous other species of chalcid fig wasps also utilize figs (syconia), but do not pollinate them. Ficus benjamina is cultivated in numerous countries as an ornamental tree and supports a rich fig wasp fauna. F. benjamina is a monoecious species, with individual figs that produce seeds, pollinators and other fig wasps. Variation in fig wasp community structure within different parts of individual trees was studied at Xishuangbanna, Yunnan, China. Thirty mature figs were collected from the top, middle (east, south, west, and north) and bottom (east, south, west and north) of three trees. The pollinator Eupristina koningsbergeri and 12 non-pollinating fig wasps were reared from the 810 figs.There were also no significant differences in the diversity index (Shannon*ƒ*?"Wiener) and evenness index (Pielou) in figs from different compass directions, but the diversity indices in figs from the top and middle of the trees were significantly higher than at the bottom. One possible explanation for this is that, unlike the pollinators, most non-pollinator females lay their eggs from the outside of the figs and some species may be subject to more disturbance lower down the trees. Both the numbers of individual pollinators and non-pollinators in the figs did not vary with bearing or height. It showed that non-pollinators make full use of the resources of host in order to ease resource competition in pollinators, nonpollinators and between pollinators and non-pollinators. It was beneficial to stabilize fig-fig wasp mutualism.

Biodiversity Inventories and Conservation. Part II

Room 7: Miguel Hidalgo (Second Floor)
Building: Colegio Primitivo de San Nicolás de Hidalgo
Tuesday July 17

14:00 SPACIAL DISTRIBUTION THE COMMUNITIES OF ORCHIDS EPYPHYTIC IN THE RAIN FOREST AND CLOD FOREST IN THE EJIDO VILLA DE GUADALUPE, HUIMANGUILLO, TABASCO, MEXICO.
Almeida-Cerino Carlos; CASTILLO_ACOSTA OFELIA; VALDEZ-HERNANDEZ JUAN
BIOLOGIA, UNIVERSIDAD JUAREZ AUTONOMA DE TABASCO; BIOLOGIA, UNIVERSIDAD JUAREZ AUTONOMA DE TABASCO; COLEGIO DE POSGRADUADOS
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This study examined the compositions of an epiphyte community of orchids and spatial distribution in tropical rain forests and cloud forest in Villa Guadalupe, Huimanguillo, Tabasco. We were sampled two transect of 500 m. Each on transect were samples 40 host tree or phorophytes. Each phorpophyte was divided into 4 classes or vertical zones according to Johansson, 1974. All epiphyte growing on these phorophytes were counted and identified. 65 epiphytes were found growing. 28 genus.A higher abundance of epiphytes occurred at zone 2 or lower canopying tropical rain forest 36.8 %, zone 3 or middle canopy in Cloud Forests 30.1 %, probably because of an intermediate light incidence at these positions. Phorophytes Tabebuia guayacan in rain forest was growing 14 epiphytes orchids species and phorophyte Calophyllum brasiliensis was growing 22 epiphytes orchids species. The epiphyte community of orchids was represented for 25 new reports for Tabasco Arpophyllum giganteum, Elleanthus cynarocephalus, Epidendrum eustirum, Epidendrum cf skutchii, Stelis microchila, Trichopilia cf tortilis y Trichosalpinx foliata

14:20 Biogeography and diversity of tree species of the Maya Mountains, Belize: a comparison of igneous and limestone substrata.
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Floristic differences among temperate communities on different geological substrata have been known since ancient times. However, geobotanical comparisons are often confounded by differences in disturbance history, topography, and geographical distance. The objective of this study was to compare the diversity and geographical affinities of tree species as a function of geological substrate and topography in undisturbed areas of the Maya Mountains. Transect censuses revealed significant effects of substrate and topography on composition, species richness, and phytogeographic affinities of tree species among adjacent substrata. Non-metric multidimensional scaling revealed significant, large differences in the species compositions among forest types based on substrata. In fact, forest types on different substrata rarely shared more than 10% of their species, despite being virtually side by side in the landscape. Edaphic rather than geographic differences may be driving these differences in composition. Forests on

igneous substrata were more species rich than limestone forests, however tree densities were twice as high on igneous than those of limestone forests. Phytogeographical affinity showed a significant relationship with relative elevation on limestone, but no such relationship was exhibited for forests on igneous substrata. With increasing elevation, limestone forests become increasingly dominated by northern Mesoamerican and Antillean taxa, but igneous forest showed no effect of topography on phytogeographic affinity.

14:40 Modern pollen rain-vegetation relationships from the lacandon forest, Chiapas, Mexico
Dominguez Vazquez Gabriela; Islebe Gerald A.
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The relationship between pollen deposition and local vegetation composition was investigated from the Lacandon forest (Chiapas, Mexico) from moss polsters. The Lacandon forest is very important for its high diversity, being covered by a mix of tropical and temperate forests. One hundred sixty taxa of pollen were recorded; Moraceae, Leguminosae, Rubiaceae, Ulmaceae, Bursera and Protium were related with lowland tropical forests. Pinus, Quercus and Mimosoideae were related with montane rain forest/pine-oak forest (MRF/POF). Arboreal anemophylous pollen taxa were the most important elements in the pollen spectra, which indicate a regional signal of the vegetation.

15:00 Coffee Break

15:20 CONVERSION OF ARAUCARIA FOREST TO ECOLOGICALLY-SUSTAINABLE TREE MONOCULTURES: PATTERNS OF ALPHA DIVERSITY FOR TEN TAXONOMIC GROUPS
Ganade Gislene; Fonseca Carlos Roberto; Baldissera Ronei; Becker Carlos Guilherme; Boelter Carlos; Brescovit Antonio; Fleck Tomas; Fonseca Vanda; Kaffer Marcia; Leal-Zanchet Ana; Marcelli Marcelo; Mondin Claudio; Paz Claudia; Petry Virginea; Putzke Jair
Unisinos ; Unisinos ; UFRGS; Unisinos; Unisinos; Instituto Butanta; Unisinos; Unisinos; Unisinos; Unisinos; Instituto Botanico; Pucc; Unisinos; Unisinos; Unisc
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We investigated how the conversion of native forest to ecologically-sustainable tree monocultures can modify patterns of species richness of a wide range of taxonomic groups. Surveys of mammals, birds, frogs, insect galls, spiders, flatworms, trees, epiphytes, lichens and fungi were performed in three replicates of each of the following four vegetation types: native Araucaria Forest and monocultures of Araucaria, Pinus and Eucalyptus trees located at the Sao Francisco de Paula National Forest, southern Brazil. We considered the tree monocultures studied ecologically sustainable because they were surrounded by native forest and possessed small size and long rotation cycles. More than 50% of the species surveyed at native forest areas were able to colonize tree monocultures. Mammals and frogs were the most efficient colonizers. However, species richness generally declined in plantation areas, and for six taxa, species richness was

higher in plantations of the native tree Araucaria angustifolia in relation to exotic tree plantations of Pinus and Eucalyptus. Richness of birds, trees, insect galls, fungi, flatworms, mammals and epiphytic plants were significantly positively correlated with a wide range of taxa (R ranging from 0,61 to 0,86). However, frogs, spiders and lichens neither had their changes in richness related to vegetation type nor their richness was significantly correlated with more than two different taxa. Plants and insect galls were the best indicators of overall diversity loss due to forest conversion to monocultures. We conclude that ecologically sustainable tree monocultures may contribute to the maintenance of species diversity for a wide range of taxa at the landscape scale.

Ecology and Conservation of Mammals. Part II

Room 8: Enrique Shuls (Second Floor)
Building: Colegio Primitivo de San Nicolás de Hidalgo
Tuesday July 17

14:00 Studying large and medium sized terrestrial mammals in a lowland rainforest in southeast Peru, through the use of camera traps
Carrillo-percastegui Samia ; Tobler Mathias; Powell George
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During 2005 and 2006 we carried out two 60 day camera tarp surveys in an unbroken tract of tens of millions of hectares of Amazonian lowland forest in southeastern Peru. The largely intact condition of the study area gave us a rare opportunity to study an ecosystem with a mammal community relatively unaffected by anthropogenic changes. . Cameras were set in a 52 kms area, including two main habitats: terra firme and flood plain forest. During the first survey we obtained 508 photographs of 25 species, 21 species of mammals and 4 species of birds during a total of 1440 camera days. In 2006 we obtained 814 photographs of 31 species, 27 species of mammals and 4 species of birds, during a total of 2340 camera days, recording 78% and 89% of the total large and medium seized terrestrial mammals know from the area. For ungulates, the species with the largest number of events were white lipped peccaries (Tayassu pecari: 210) and tapirs (Tapirus terrestris: 102), among felines, jaguars (Panthera onca: 51) and ocelots (Leopardus pardalis: 46). The survey confirmed the presence of elusive species such as Short-eared dog (Atelocynus microtis), Jaguarundi (Puma yagouarundi) and Crab-eating raccoon (Procyon cancrivorus), as well as Giant Anteater (Myrmecophaga tridactyla) and Collared anteater (Tamandua tetradactyla). Data shows that collared peccaries (Pecari tajacu), and grey brocket deer (Mazama gouazubira) have a preference for terra firme forests, ocelots are more abundant in floodplain forest and all the other species showed no habitat preference. White lipped peccaries, collared peccaries and grey brocket deer are diurnal while cougars (Puma concolor), ocelots, tapirs and red brocket deer (Mazama americana) are nocturnal and jaguars cathemeral. Camera traps were a very reliable tool for studying the presence, habitat use and activity patterns of mammal species in tropical rainforests.

14:20 PREDICTIVE HABITAT AND POPULATION VIABILITY MODELS FOR JAGUARS (PANTHERA ONCA) IN THE SIERRA MADRE ORIENTAL, MEXICO
Ramirez Bravo Osvaldo Eric; Lopez Gonzalez Carlos Alberto
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Due to habitat loss, it is necessary to identify areas with potential viability for endangered species. In the case of jaguar (Panthera onca) little is known for extreme distributional

areas, making it necessary to create conservation strategies to assure long term survival. For this purpose, a spatial dynamic model (PATCH) was used to determine priority areas in the Sierra Madre Oriental, Mexico. It was developed, with a static model created estimating mortality (human population density and paved road density) and survival (vegetation index and physiographic aspects) probability. Demographic information used, was previously published. Three scenarios were considered: actual conditions, human population growth in 15 years, and paved road density increase in 15 years. Results show that actual conditions provide sufficient habitat for jaguar survival in a 200 year span. However, increase in human population and road density will result in species extinction in a 50 year span with an increase in possible conflicts. The results of this model will help to concentrate resources into certain areas to assure long term survival for jaguar populations.

14:40 Habitat Preferences on white-lipped peccary groups in Calakmul Forest, Mexico

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The white-lipped peccary (WLP) is an endangered social species that forms the largest ungulate groups living in dense tropical forest. We studied four groups of WLP in the largest tropical protected area in Mexico, the Calakmul Biosphere Reserve (CBR) where four vegetation types can be easily distinguished. The objectives were among others to estimate habitat preferences and seasonal differences in the use of these forest types for this species. We captured and attached radio-collars to individuals belonging to four groups. Using radio-telemetry we were able to locate the groups for several periods of time, however, because the forest types are highly mixed and the radio-telemetry error was bigger we favored the homing method of approaching the groups and followed them through the forest. In that way we obtain an accurate estimation of time spend in each of the forest types. After 18 months, and accounted for autocorrelation, 371 location points from the four groups were related to one of the four vegetation types. We estimated habitat preferences by three methods: Neu-Chi Square and Bonferroni intervals Johnson Ranking Method and Aebischer Compositional Analysis. We estimated WLP second and third order selection according to Johnson (1980). Consistently, groups of WLP showed high preferences for ponds and avoid dry forest, when ponds were removed from the analysis, the medium semi-perennial forest (medium) and flooded forest (flooded) were preferred and again dry forest was avoided. When seasonal effects was taking into consideration groups visited more the medium forest almost all year and specially between June-August when the Ramon tree (Brosimum alicastrum) is fructifying, but flooded preferences were higher in the peak of the wet season when earthworms were highly abundant. This species is highly selective and depends largely in water availability as well as forest combining medium and flooded forest.

15:00 Coffee Break

15:20 Habitat preferences of ungulates in fragmented landscapes in the Selva Lacandona, Chiapas, Mexico.

Tejeda Carlos ; Naranjo Eduardo
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With the objective of knowing the habitat preferences of five ungulate species under conditions of habitat fragmentation in the forest frontier of the Selva Lacandona, Chiapas, we carried out systematic track counts in 19 lineal transects located in two places (Rio Azul and Ixcan) in the Southwest portion of the Selva Lacandona between the months of September of 2005 and December of 2006. The null hypothesis outlined that the ungulates do not present habitat preferences and they are distributed proportionally according to the habitat availability. Each counted tracks was related with one of the 13 different habitat types defined by the combination of a geomorphologic unit and a vegetation type cover. We walked 6,834.5 km and we found a total of 2023 ungulate tracks. The white lipped peccary (Tayasu pecari) tracks were found, in both places, only in tropical rain forests associated to water bodies. The tapir (Tapirus bairdii) showed preferences for the karst forest in Rio Azul and for the low hill forest and alluvial forest in Ixcan. The red brocket deer (Mazama americana) preferred the karst forest and the alluvial plain secondary vegetation in Rio Azul and the alluvial forests in Ixcan. The collared peccary (Pecari tajacu) was generalist specie in Rio Azul, whereas, in Ixcan, it preferred the perturbed low hill forest. The white tailed deer (Odocoileus virginianus) showed preferences for the perturbed low hill forest, perturbed alluvial forest, and secondary vegetation in low hills and alluvial plains, while it preferred only the perturbed low hill forest in Ixcan. The differences in the habitat availability among places are mainly determined by geomorphologic differences and by different soil use patterns in the ƒ?oejidosƒ?? located in each site of study. Finally we suggest habitat and ungulate population management actions.

15:40 Individual identification of paca (Cuniculus paca) by tracks

Contreras-Diaz Rusby Guadalupe; Santos-Moreno Antonio; Alfaro Ana Ma.
IPN CIIDIR - Oaxaca; IPN CIIDIR - Oaxaca; IPN CIIDIR - Oaxaca
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Many studies about the distribution of medium or large mammals are based on the analysis of tracks. However, these are of poor value in the estimation of abundance or population size at specific sites. So, the present study had as objective to design a method that can identify individual pacas (Cuniculus paca) using their track characteristics and to apply it in the field. Plaster casts were obtained from the tracks of captive individual pacas, and six linear measures and one angle were taken. To determine if secondary sexual dimorphism exists, a Wilcoxon test was applied to each variable. A Principal Component Analysis (PCA) was applied over a correlation matrix of standardized data. For the application of the method in the field, plaster casts were obtained in a linear transect of one km of length established at the edge of the Soyolapan river, in San Mart¡n Soyolapan, Municipality Santiago Comaltepec, Oaxaca, during two periods of four days each, in December 2006 and January 2007. Finally, the field values were compared with the captive pacasƒ?T values. From the previous analysis, no significant statistical differences were found between male and female tracks, so we concluded that secondary sexual dimorphism in paca tracks does not exist. By means of PCA it was possible to identify 81.81 % of the individuals analyzed. When applying this method an abundance of 16 individuals was estimated for the San Mart¡n Soyolapan site.

16:00 Noahâ?Ts first task: priority and irreplaceable ecoregion sets for Neotropical vertebrate conservation

Dias Loyola Rafael; Kubota Umberto; Michael Lewinsohn Thomas
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The Neotropical region harbors the largest extant biodiversity areas and it is the last tropical region in which large-scale policy decisions can still be made. Using the WWF database of 10,051 vertebrate species in 179 Neotropical ecoregions, we evaluated the effectiveness of various indicator groups for representing overall diversity. Ecoregions represent the upper scale limit at which operational choices can be considered and implemented, given that most conservation decisions and policies are constrained within national boundaries. We sought priority sets of ecoregions for conserving Neotropical terrestrial vertebrates. We evaluated richness of total, endemic, or threatened species. Priority ecoregion sets were achieved by a stepwise heuristic algorithm, based on complementarity. We demonstrate that even the best surrogates include most ecoregions in the priority sets, rendering them unfeasible. Hence we combined representation of total, endemic and threatened species at a cutoff level of 80%, to reconcile representation area effectiveness. This resulted in a priority set of 49 ecoregions representing at least 90% of total richness, 82 and 86% of all endemic and threatened species, respectively. These ecoregions are well spread across the Neotropical region. Within the priority set, the subset of irreplaceable ecoregions concentrates in parts of Northern Mexico, the Andes, Central and Southeast Brazil, and Southern Chile. This set comprises only 11 ecoregions, representing at least 55% of total richness, 27% and 38% of all endemic and threatened vertebrates, respectively. Indicator groups proved to be effective surrogates for identifying and enhancing conservation strategies in the Neotropics, but not for setting priority ecoregions across the entire realm. The modern Noahƒ?Ts first task is to ensure that a large range of biodiversity is represented in areas recommended for protection. We expect this analysis to provide useful inputs for national and supranational policy proposals.

Social and Economic Drivers of Change of Tropical Ecosystems. Part II

Room 9: Aristóteles (Second Floor)
Building: Colegio Primitivo de San Nicolás de Hidalgo
Tuesday July 17

14:00 A Comparison of Land Use /Land Cover Change in Two Regions of the Selva Maya: Socioeconomic and Institutional Drivers of Deforestation and Forest Conservation
Ellis Edward Alan; Porter Bolland Luciana
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Deforestation remains a major environmental problem in Mexico after more than 20 years of efforts by scientists, international and national NGOs and government institutions to conserve its tropical forests and biodiversity. However, current research on land use/cover change (LUCC) has revealed contrasting deforestation processes among tropical regions of Mexico ranging from forest cover maintenance to severe deforestation. The objective of this study is to compare LUCC in two regions of the Selva Maya and identify the major socioeconomic and institutional drivers associated with forest cover loss and maintenance. Based on remote sensing analysis and extensive field research we compare LUCC and examine key socioeconomic and institutional drivers related with land use in two study sites of the central Yucatan Peninsula: the northern portion of the Calakmul Biosphere Reserve (CBR) in Campeche, and the Maya Zone of central Quintana Roo. Pathways in LUCC may vary according to economic and institutional drivers. Results show different annual deforestation rates among the two study regions, being greater in the Campeche site (0.7% from 2000 to 2005) compared to the Quintana Roo site (0.01% from 2000 to 2004). Land use in Quintana Roo has been influenced by community forest management incentives supported strongly by international projects through institutional strengthening and technical assistance. Lower deforestation rates in Quintana Roo are associated with the presence of Permanent Forest Reserves established in community forestry based ejidos. The Campeche site is characterized by the typical deforestation process of an expanding agricultural frontier, mainly with cattle ranching. Although, conservation efforts have been pursued with the creation of the CBR, policy that supports sustainable productive systems and reduces deforestation has been absent. This comparison suggests that sustainable use strategies may be more effective at reducing deforestation than formal protected areas.

14:20 THE ENVIRONMENTAL AND ECONOMIC IMPACTS OF MANGROVE CONVERSION
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For this study a set of surveys were carried out within a designated Ramsar site (La Mancha*ƒ*?"El Llano, Veracruz, Mexico) as the basis for a case study of the impacts of

conversion to cattle pasture on an ecologically important mangrove ecosystem. Three of the main economic mainstays of the local economyÖó the fisheries sector, the cattle raising sector and the ecosystem*ƒ*?Ts functions and services are assessed in terms of the potential for development compatible with mangrove conservation. The scope for the mitigation of mangrove conversion to pasture, the legal and economic (policy) instruments available, the economic value of conversion, the question of what is being lost through conversion and the alternative development paths are discussed.
Site specific data is generated through a set of surveys (contingent valuation) and is analysed. Sample sizes were small with four to five interviewees. Based upon the surveys the following estimations were madeÖó
1. The lagoon represents annual profits from a combination of fish, oyster and clam production of at least Mex$ 2,001,352 ($ 184,929).
2. A typical cattle raiser owns three plots of land, about 37 hectares in total, in both dry and humid areas, pays nothing for access to water (though his head of 47 cattle are sustained by the fresh water holes or streams on his land) and makes an annual profit of Mex$ 66,004 ($ 6,099) a year, less than the typical fisherman*ƒ*?Ts annual earnings (Mex$ 73,909 or $ 6,829).
3. The ecological expert*ƒ*?Ts estimates of the annual investment in protection measures (maintenance of a private conservation reserve and the prohibition of tree felling) ranged from Mex$ 80,000 ($ 7,392) to Mex$ 100,000 ($ 9,240). The annual value assigned to the 70 hectares of the CICOLMA reserve ranged from Mex$ 500,000 ($ 46,200) to Mex$ 796,000 ($ 73,552). The value assigned to one hectare of mangrove ranged from Mex$ 15,000 or $ 1,386 to Mex$ 1,000,000 or $ 92,4002.
Alternative policy objectives are discussed based on the results of the surveys. Finally recommendations are made based on the evidence presented and further studies are outlined.

14:40 Land use impact in the inland water-land ecotones of the Orinoco lowlands: the patterns and fractal analysis

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This work analyzed the land use changes on the structure, dynamic and functioning of the inland water-land ecotones (i.e Morichals) of the Orinoco lowlands. These systems are found in the river headlands of the dissected lowlands, where the soil is saturated by the groundwater. We considered the following. If elucidating the mechanisms permitting ecotone sustainability with understanding the dynamic of ecotone system is a major challenge in ecotone ecology, then the dynamic array of possible ecotones and landscape fragmentations should capture the complex behaviors inherent in ecotones. In the morichal Los Sunsunes, Venezuela, the changes of the woody cover and patch

fragmentation were evaluated using aerophotographs (missions of the years 1977, 1992 and 1997) and geographic information systems. Results indicate that changes the phreatic level experienced a substantial drawdown and the vegetation pattern was fragmented through time. The patch size ranged from 5 to 177493 m2, and the patch density spanned from a maximum 0.1132 patches m-2 in 1977 to 0.0143 patches m-2 in 1997. The resulting woody cover varied from 17.0 percent in 1977 42.6 percent in 1997. For each mission, the resulting patch size was ordered in a rank size distribution (Sornette et al., 1996), and adjusted to fractal models (Milne 1991; Palmer 1992). From 1977 to 1997, the rank patch distribution was fitted by the stretched exponential distribution model (LaherrÇùre & Sornette, 1998) which depended on the dynamics of the largest but less abundant patches. The multiplicative levels of the cascade (i. e. 1/c) reflecting the patch dynamic increased from 16 in 1977 to 100 in 1997. The parameter c decreased from 0.06 in 1977 to 0.01 in 1997. The temporal increase in woody cover and variations in the fractal distributions reflected the invasion by woody species from the nearby dry savannas.

15:00 Coffee Break

15:20 Mesoamerican Biological Corridor: Was the message delivered?

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Conservation projects are not frequently evaluated on their longer-term outcomes. The Mesoamerican Biological Corridor Project (MBCP) was a multinational innovative initiative that promoted the connection of protected areas through biodiversity-friendly land use practices. The project used different communication channels expecting to increase knowledge about the project and the concepts of natural protected areas (NPA), biological corridors and sustainable development by at least 10%. In 2001 MBCP conducted a public survey in cities within transnational conservation priority areas, throughout all Mesoamerican countries. To assess changes in local knowledge, I repeated in 2006 the 2001 survey verbatim, following the same random sampling frame used in previously surveyed communities within ƒ?oTrifinioƒ??, a MBCP priority area located where the borders of Guatemala, Honduras and El Salvador meet. I compared data from 620 surveys from 2001 to 600 from 2006. Using the theory of diffusion of innovations (DoI) I identified effects communication processes had on changes of public local knowledge of MBCP and its concepts between 2001 and 2006. Local awareness of MBCP decreased 5.9%, from 8.2% (n=51) in 2001 to 2.3% (n=14) by 2006 (Xsquared 1df p<0.000). However, means of knowledge from individual questions and mean of an index evaluating overall knowledge of MBCP concepts increased in 2006 among the entire population, and among respondents exposed to MBCP. More educated and male respondents attained higher knowledge levels, as predicted by DoI and other human behavior studies. Television and posters were the most frequently cited source of MBCP, while television and word of mouth were the preferred source for obtaining local news. Conclusions from knowledge increment among population exposed to MBCP should be drawn with careful considerations due to small sample size in spite of statistical significance. Simpler media such as word of mouth and posters should be also considered when addressing local populations.

15:40 Perceptions and knowledge of rural people towards the ecological roles of vertebrates in shade coffee plantations in Cuetzalan, Mexico

Lopez del Toro Paulina; Andresen Ellen; Barraza Lomeli Laura
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Shade-coffee plantations are recognized as important tropical agro-ecosystems in terms of the biodiversity and ecosystem functions that they conserve while at the same time producing crucial monetary income for local communities. People living in shade-coffee communities usually appreciate the diversity of useful plants and some of the ecosystem functions being protected by this agro-ecosystem, such as control of soil erosion and the maintenance of soil fertility. Farmers usually also have very good knowledge regarding the species of vertebrates inhabiting their coffee plantations. But, are they aware of the important ecological roles that these animals are performing and that are crucial for the well-being of the agro-ecosystem? To answer this question, we worked in a coffee cooperative in Cuetzalan (Puebla, Mexico), where an Environmental Education Program (EEP) has been implemented since 2004 through workshops with farmers and school children. An open interview was applied to 36 male farmers and a written questionnaire to 120 students (first year of secondary school). In both cases half of the subjects had participated in the EEP workshops, while the other half had not. We found that perceptions of farmers and students towards vertebrates were, in general, positive for the birds and negative for snakes and bats. The degree of knowledge was high for the role vertebrates play in pollination, intermediate for biological control, and low for seed dispersal. For the farmers, only 4 of 29 questions showed significantly different answers between both treatments, being higher the degree of knowledge of farmers who had taken the EEP workshops. In the case of students, more than half of the answers (total of 32 questions) were significantly different between the two treatments, such that students that had taken the EEP workshops had a more positive perception and a better knowledge of the ecological roles of vertebrates.

Ecosystems services

Room 10: Manuel Altamirano (Second Floor)
Building: Colegio Primitivo de San Nicolás de Hidalgo
Tuesday July 17

14:00 How the relationship between biodiversity and ecosystem function can be detected in a natural varying environment?
Ruiz-Jaen Maria C.
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Experimental studies assessing the role of biodiversity and its effects on ecosystem functioning have generally shown that a decline in species number has negative effects on ecosystem functioning. Even though, this relationship has been intensively study in the last ten years, little is known about this relationship in natural communities where species diversity is not manipulated. I studied the effect of biodiversity on ecosystem function in a lowland tropical forest in Panama. Specifically, I examined how carbon content in a patch is explained by species dominance and identity. This approach maximized the possibility of sampling in areas of both high and low dominance by using randomly stratified sampling. Overall, no difference in carbon content was detected between low and high dominant patches. However, evidence showed that trees contribution to carbon content is species specific in our system.

14:20 Carbon stocks and emissions dynamics, derived from land use change process
Ordonez Diaz Jose Antonio Benjamin; Masera Omar; Garcia Oliva Felipe; Ruiz Luis Gerardo; de jong Ben
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This study intends to estimate, carbon content in aboveground biomass (AB) litter and soil in ten different land cover-land use classes (LC/LU) in the Highlands in Central Mexico, to understand carbon losses and dynamics by stock and by land conversion process, as a consequence of the human activities influence to increase carbon dioxide concentrations in the atmosphere, and its impact in global climate change.
Total carbon estimated in this research, register an interval from 82.7 to 266.9 MgC/ha; based on a detailed analysis of the process of land use change within the Region, we estimate that a total of 10.37 TgC were emitted within the Region in a 14 yr period, and the carbon sequestration reached 10.36 TgC, mostly because as a result of the abandonment of agricultural lands and the recovering of secondary forest. The net carbon flow (emission minus sequestration) in the reached was 14.9 GgC.

14:40 Carbon sequestration project, from integral management of the common resources options, for indigenous and rural communities in Oaxaca, Mexico
Perez-Gonzalez Carlos Marcelo; Vasquez Barranco Ines Guadalupe; Rodriguez-

Rojas Elizabeth; de la Rosa-Pablo Fermin Rafael; Ordonez Diaz Jose Antonio Benjamin
SAO; SAO; SAO; SAO; Facultad de Ciencias-UNAM
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The state of Oaxaca, Mexico held the highest biodiversity in the country, concentrates almost 12,974 species of flora (8,431) and fauna (4543) and contains a considerable number of endemism; 80% of the land is own by communities and Ejidos.
The organization Servicios Ambientales de Oaxaca (SAO) had been development a methodology for evaluation the carbon sequestration potential capability in 15 indigenous and rural communities of Oaxaca State.
Before selecting communities to participate in the project, it was necessary for each one to complete a land ordination study to evaluate land use. The project considers the management of protected and community areas and intervention in the following productions systems:
a) Restoration of acahuales (fallow land), b) Sustainable agriculture, c) Agroforestry systems, d) Enriched shaded coffe and e) Forest restoration.
The carbon sequestration potential averages are about 18,000 MgC/yr; SAO has developed a carbon pilot project on this communities.

15:00 Coffee Break

15:20 Long-term impacts of fuelwood harvesting and the potential for provision of ecosystem services of tropical montane cloud forests in central Veracruz, Mexico

Ruger Nadja; Williams-Linera Guadalupe; Huth Andreas
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The area covered by old-growth tropical montane cloud forest (TMCF) in central Veracruz, Mexico, has decreased rapidly over the last 50 years. Deforestation has been accompanied by an increased utilization pressure on remaining forest fragments but also by an increase of area covered with secondary forest. Both, old-growth and secondary TMCF provide important ecosystem goods and services (e.g. fuelwood, biodiversity conservation, regulation of the water cycle, soil protection). We aim to investigate (1) the long-term impact of fuelwood harvesting on structure and composition of old-growth forest and (2) the potential of secondary forests for provision of ecosystem services. We apply the process-based forest model FORMIND to simulate different scenarios of fuelwood harvesting in old-growth forest as well as the recovery time of relevant forest characteristics for provision of ecosystem services in secondary forest.
Impacts of selective logging for fuelwood on forest structure and composition increase linearly with the amount of harvested wood volume. Even at low levels of harvesting, forest structure becomes more homogeneous in the long term, because large old trees disappear from the forest. These changes may sometimes be detected only after several decades. We estimate that secondary forests aging 40 years are able to effectively regulate the water cycle and protect the soil because relevant structural characteristics

such as forest height and leaf area index have largely recovered. In contrast, similarity of the species composition to old-growth conditions, as indicated by the number of large old trees and the proportion of basal area of different tree species, is achieved only after150 to 300 years. Young secondary forests have a high potential to supply fuelwood and their rational management could therefore substantially alleviate logging pressure on remaining old-growth forests.

15:40 Nest tree specificity, pollen utilisation and impacts of firewood collection on carpenter bee populations in India

Somanathan Hema
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We studied nesting, foraging and flight activity in three sympatric species of carpenter bees in the Western Ghats of India. They have different temporal activity periods with Xylocopa tenuiscapa and X. ruficornis being diurnal while X. proximata is nocturnal.The heterogenous vegetation consists of a matrix of highly fragmented seasonal cloud forest, open grassy patches, grazing lands and slash-and-burn agricultural land. All three species nest in dead wood but show specificity in the species of dead wood that are utilised to construct nest tunnels. X. tenuiscapa is a nest tree specialist on Syzygium cumini , while the nocturnal X. proximata nests in trees such as Ficus racemosa, Xantolis tomentosa and Bridelia retusa. X.ruficornis which is smaller in body size than the other two species are found to nest in dead branches that are smaller in diameter and are nest tree generalists which nest in many tree species such as Ficus racemosa, Xantolis tomentosa, Olea dioica, Randia dumetorum and Terminalia chebula. The three species nest inside intact forest patches as well as in areas that have been cleared for crops and have wooden stumps of cut trees or sparse tree cover. Analyses of pollen loads removed from the bodies of the three bee species indicate that they collect wild, crop and exotic pollen. The number of pollen grains collected by these Xylocopa species is very large compared to honey bees such as Apis cerrana and Apis dorsata that co-occur in the study site. The large number of grains/ pollen load, their floral constancy, large flight distances and trap lining behaviour make them important agents of pollen flow in this ecosystem. Dead wood is extensively collected for fuel and timber by local communities in Bhimashankar. We discuss the implications of these practises for carpenter bee and plant populations.

16:00 Setting up Long Term Eco-Hydrological Monitoring Basis for the Cuitzmala River Basin

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Since 1981 the National Autonomous University of Mexico lunched a Long Term Ecological Research Project in the Mexican Central Pacific Coast to understand the structure and functioning of the Mexican Tropical Dry Forest. Nowadays, recognizing a remarkable heterogeneity of tropical dry environments and their connectivity to upper basin conditions with more temperate climates, a landscape classification was needed to guide future research and data collection efforts at larger spatial scales. Furthermore, as

a template for developing the Mexican LTER network, an eco-hydrological classification might help establish a regional context for LTER sites. Therefore, a window is open to produce new insights into dynamics of natural systems, using data from a LTER monitoring network within the same eco-hydrological conceptual framework. The objective of this work was to propose a regionalization scheme for the Cuitzmala river basin, using an eco-hydrological conceptual framework to identify areas which summarize landscape heterogeneity for future monitoring efforts within the LTER network. With this purpose in mind the Cuitzmala basin was divided using the Sub-catchments criteria, recognizing these sub-units as Ecohydrological Response Units (EhRU) that integrate unique combinations of climate, vegetation, geology/geomorphology, and human settlements. Ecohydrological Response Units are part of an ƒ?oevent ƒ?" structure ƒ?" eventƒ?? conceptual framework, where precipitation represents the trigger factor which promotes a response over the organization and structure of spatial elements, such as watershed area, geomorphology, vegetation land cover, human settlements, drainage network, and lithology. Finally, a decision matrix to identify monitoring sites was generated to maximize capture of representative data on landscape heterogeneity.

Ecology & Conservation of Birds. Part I

Room 6: Sala 2 (Second Floor)
Building: Centro Cultural Universitario
Wednesday July 18

10:00 From Forests to Cities: Effects of Urbanization on a Neotropical Bird Community
MacGregor-Fors Ian; Morales-Perez Lorena; Schondube Jorge E.
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Urbanization modifies natural habitats affecting biodiversity at local or regional levels. To understand how urbanization affects bird diversity we studied the bird communities of native forest and urban habitats in a region of west Mexico. We surveyed resident birds at original habitats (pine-oak and oak forests) and within Morelia city. We measured habitat attributes at both forests and the city to characterize sampling points. Our results show a change in bird diversity when the original forest habitats are replaced by the urban system. Bird species richness showed a negative relation to urbanization, while bird abundance was positively related to it. This trend seems to be explained by the loss of a large number of native species due to natural habitat replacement, and to the invasion of the city by two exotic species. Several urban attributes affected bird diversity. Bird species richness was positively related to tree foliage, and herb coverage, and negatively affected by human activity. Bird abundances were positively related to building, and herb height. Human economic level seems to have an effect on bird diversity, with high-income residential areas presenting the highest bird species richness.

10:20 Analysis of Distribution and Abundance of an Endangered Tropical Bird by Means of Machine-Learning Methods: the Ocellated Turkey (Meleagris ocellata) in Yucatan peninsula, Mexico
Kampichler Christian; Calme Sophie; Weissenberger Holger
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The Ocellated Turkey (Meleagris ocellata) (OT) is a large, unmistakable endemic bird of the Yucatan peninsula. It has long been recognized as one of the most important gallinaceous species for subsistence hunting; it is still the case nowadays in poor rural areas where the species exists. Moreover, it is a prized game species for sport hunters, who mostly hunt males for trophy. The biology and ecology of the species, however, still are widely unknown; handbooks cite the OT as "remaining a mystery" (Porter 1994 in Handbook of the Birds of the World, Vol.2) and characterize it as a species with "high research priority" (Stotz et al. 1996, Neotropical Birds - Ecology and Conservation). For the first time, its past and present geographic range was systematically assessed less

than 10 years ago ƒ?" until 2000 only anecdotic distributional data had been collected. The assessment shows a considerable decrease in OT abundance and distribution between 1980 and 2000. The available information, however, still is lacunary: In a distributional map based on a 10x10 km grid, more than 50% of the grid squares are labelled with "no data". Our aims were two-fold: (1) to interpolate gaps and produce the most detailed map on OT distribution ever available, (2) to identify the environmental and social correlates (variables on vegetation cover and land use forms; human population density, number of settlements of different size, etc.) that can explain the distribution and abundance loss of OT. We applied classification trees and random forests -- an advanced method of constructing multiple tree-based classifiers and ensemble forecasting ƒ?" for model generation. Actual distribution is best predicted by the presence of large contiguous populations; distribution and abundance loss are related to a drop of forest cover below 50% and to the uncontrolled foundation of new small settlements.

10:40 Conservation of endemic birds in montane successional mosaics in Western Mexico.
Santana C. Eduardo; Contreras Sarahy; Schondube Jorge; Jardel Enrique; Munguia Heriberto
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One of the principal strategies for achieving the conservation of tropical birds includes the identification of regions that harbor a high proportion of endemic species to be protected. IUCN and Bird Life International have identified Endemic Bird Areas (EBAS) as one of the criteria for establishing regional conservation priorities. However, aside from identifying the ecosystem, life zone, ecoregion or plant community where the endemic species are found, little is known about their habitat requirements and management needs. Based on a sampling effort of over 42,500 mistnet hours and 858 point-counts along a cloud forest successional gradient in the subtropical Sierra de Manantlan Biosphere Reserve, Jalisco, Mexico, we recorded a total of 221 bird species of which 30 (14%) are endemic to Mexico and 52 (24%) to Mesoamerica. Secondary scrub vegetation had more Mexican endemic species than mature cloud forest or pine forest. Habitat use and selection analyses showed that a significant number of endemic species require early stages of vegetation succession to survive. Their conservation will involve not just habitat protection, but the maintenance of habitat-specific disturbance regimes that create a mosaic of successional gradients in a given landscape. Fire dynamics research in the Sierra de Manantlan shows that the main forest types are exposed to (or maintained by) different fire-related disturbance regimes. The conservation of the montane endemic birds of western Mexico will depend on our ability to either preserve or imitate these disturbances. This task will become more difficult overtime considering the climate changes expected for this region of tropical North America.

11-00 Coffee Break

11:20 RECOVERY OF TROPICAL AVIFAUNA IN RELATION TO FOREST SUCCESSION FOLLOWING SLASH-AND-BURN AGRICULTURE AT CALAKMUL BIOSPHERE

RESERVE, CAMPECHE, MEXICO.
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We studied bird community structure and composition in relation to forest succession after slash-and burn agriculture in Campeche, Mexico. Replicate fallow sites abandoned after cultivation ranging from one to thirty years of succession were compared with primary semievergreen forest older than 75 years using fixed radius point count sampling. In our comparative analysis, we found that mature forest had the highest species richness, but did not differ significantly from that of 20-30 years old secondary forest. Bird composition of early stages of succession differed significantly from older stages resulting in higher species richness at the landscape level than mature forest alone. Examination of distribution of individual species revealed that 42 % of them are highly dependent on mature and older successional forest, thus are likely to decline in absence of these habitats. The results of our study indicate that regional bird diversity in human managed landscapes of the Yucatan Peninsula can be maximized through slash-and-burn agriculture if disturbance frequency is kept low and fallow periods older than 20 years are allowed. The maintenance of a heterogeneous landscape that includes all stages of succession and mature forest is necessary to ensure the long-term conservation of the local avifauna.

11:40 MANAGEMENT PERSPECTIVES OF RIPARIAN SYSTEMS IN NORTHWESTERN MEXICO
José Fernando Villaseñor
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Freshwater limitations and its ever-increasing need make water management an important concern for human populations. The establishment of dams and diversions in river systems has modified natural flooding regimes, causing a decrease and loss of riparian native corridors, the invasion of exotic plants, and changes in associated animal communities. Riparian systems in northwestern Mexico constitute the northernmost distributional extensions for numerous tropical plant and animal species, contributing importantly to the biodiversity of these environments. With respect to the bird fauna, they represent the most important habitat in terms of species richness and species' abundances. From a landscape perspective, riparian vegetations and the associated river floodplains are composed of diverse habitat mosaics, and are recognized as centers of "bio-complexity" and "bio-production", playing a key role in the stability of the most important ecological processes of riparian systems. Unfortunately, floodplains constitute areas where many primary human activities take place. I use the Colorado River Delta case as an example illustrating the effects of anthropogenic changes, as well as management and restoration measures in riparian systems in the United States, and compare the scenario in the United States with that in central Sonora, where some traditional management measures have helped ameliorate some negative consequences of flow control along mid-sized river systems.

12:00 Patterns of bird species diversity in the Pantanal of Mato Grosso, Brazil

Cortes-Figueira Jose Eugenio; Cintra Renato; Rodrigo Viana Leoonardo
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The Pantanal of Mato-Grosso (Brazil), the largest floodplain in the world, is recognized as a threatened area of international importance for conservation. Large areas are covered by water during annual flooding whereas during the dry season the region becomes a vegetacional mosaic. In this work we analyze the temporal occurrence and habitat use of 317 bird species surveyed in the region of Pocone, in order to understand local community dynamics, and conservation needs. Measures of habitat similarity were based on species co-occurrence in each pair of 9 habitat types. Rank correlation was used to investigate whether the abundance (rare/common) and the number of months of occurrence of seasonal and/or resident species could be explained by the number of habitats used. The relative stability (ST) of the different habitats was evaluated by the ratio: number of seasonal to total of species, and also by the coefficient of variation of number of seasonal species during the year. The nine habitats were clustered into three categories: 1) forests: were more species rich (S=173) and more stable (ST=0.14), 2) savanna: intermediate (S=127, ST=0.24), 3) aquatic: less rich (S=102) and less stable (ST=0.40). The number of seasonal species remained relatively constant in forests throughout the year, yet increased in the other habitats during the dry season. Most of the resident and seasonal species are habitat generalists and the abundance of resident species was related to the use of multiple habitats (r_s= 0.30, $P<0.001$). Conservation of the Pantanal biodiversity relies on the conservation of habitat mosaics and annual flood cycles, threatened by anthropic fires, deforestation, industry, and by the Paraguay-Parana Waterway Project.

Forest Management and Selective Logging. Part I

Room 7: Miguel Hidalgo (Second Floor)
Building: Colegio Primitivo de San Nicolás de Hidalgo
Wednesday July 18

10:00 Forest management impacts on neotropical wet forest vegetation: a long-term experimental study at two Costa Rican sites

Finegan Bryan; Alfaro Reyna Teresa; Delgado Diego
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Sustainable forest management remains an important option for conservation outside neotropical protected areas. The destructive nature of traditional logging is well-known but few long-term experimental studies have examined the ecological impacts of formal forest management. We determined the impact of timber production on the structure, floristics and dynamics of natural tropical wet forest vegetation on hilly terrain with infertile Ultisols and Inceptisols in northeastern Costa Rica. Experiments at two sites were implemented in 1990-1992 with randomised treatments including unlogged, logged and logged plus silviculturally treated stands. Reduced-impact logging was used and intensities were low to moderate. All trees, palms and lianas >= 10 cm dbh were identified and measured using standard procedures in three replicate permanent sample plots (PSPs) of 1.0 ha per treatment per site. Individuals >= 2.5 cm dbh were evaluated in 0.2 ha subplots in two treatments at one site. Treatments were compared using ANOVAs, multiple comparison tests and t-tests. During the first years following intervention, stand density and basal area were reduced and recruitment and natural mortality rates increased after silvicultural treatment. 13 -14 yr later, however, structural and stand dynamic differences between disturbance regimes were no longer statistically significant. There were no differences of species richness and diversity for either minimum dbh at any time during the study, and disturbance-related compositional change could not be detected statistically. Lianas provided an exception to these community trends, being reduced in abundance and species richness by silvicultural treatment. In conclusion, timber harvests had only short-term impact on most forest structural, floristic and dynamic parameters, and no impact at all on some. Silvicultural treatment increased impact but is rarely used in practice. Further monitoring, experimental second harvests, modelling approaches and study of potentially vulnerable timber species are required for adaptive production and conservation in these forests.

10:20 The effect of silviculture on the recovery of overexploited mahogany (Swietenia macrophylla) populations in Bolivia

Pena-Claros Marielos; Verwer Caspar; van der Staak Daniel; Sterck Frank J.; Ohlson Kristen
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Mahogany (Swietenia macrophylla) is the most valuable commercial timber species in the Neotropics. The species has been overharvested in most of its natural range, and it is currently included in Appendix II of CITES. This study evaluates the effect of three sets of silvicultural treatments on the population dynamics of mahogany. The silvicultural treatments included different intensities of logging coupled with several pre- and post-logging interventions and were compared to an unharvested control treatment. We evaluate the hypothesis that natural regeneration and tree performance (i.e. survival, growth and recruitment) of mahogany increased with the intensity of silvicultural treatments. Data was gathered during a four year period in the plots of the Long Term Silvicultural Research Project being carried out at La Chonta Forestry Concession in Bolivia. All mahogany trees larger than 1 m in height were labelled and had the following variables evaluated: tree height, diameter at breast height, crown position, crown form, stem quality and vine load was evaluated. Seedlings (<1.3m height) were recorded and measured around 58 adult trees. Population growth was simulated using matrices constructed based on the observed survival, growth and recruitment rates. Growth was primarily determined by light availability, and increased with the intensity of logging and silvicultural treatments. Seedlings were also dispersed over larger distances in the more intensively managed plots. Matrix modelling revealed that the recovery of overexploited mahogany populations is possible if there is sufficient seed input. Consequently, silvicultural treatments that promote the existence of large seed trees and the successful establishment of seedlings are key to recuperate overharvested mahogany populations.

10:40 Treefall gaps of certified forests as regeneration sites for neotropical timber

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We studied two hypotheses based on the actions taken due to the requirements of certification: 1) timber regeneration is more successful in certified forests as compared to conventionally managed forests (due to higher abundance of mother trees), and 2) treefall gaps of certified forests provide more favourable environments for timber regeneration (due to less logging-related damage).
The hypotheses were tested against data collected from selectively logged forests in Northern Honduras. We compared logging gaps of certified and conventionally managed forests to natural treefall gaps of protected forests. In a total of 46 gaps we recorded the saplings of 10 shade tolerant and 3 pioneer timber species, along with 12 gap environmental characteristics.
We found that the gaps of certified forests were characterized by less logging-related disturbance than gaps in conventionally managed forests, which supports hypothesis 2. Even though low disturbance was expected to suit the ecological requirements of shade tolerant species, pioneers were found most abundant in certified forests, while shade tolerants were most abundant in conventionally managed forests. Thus, hypothesis 1 was only partly supported.
The surprising results could be partly explained by a high abundance of a single species, Mortoniodendron vestitum, in conventionally logged forests. To explain the low abundance of shade tolerant species in certified forests, we suggest that intensive

loggings before certification have led to a low abundance of seed trees. Pioneer timbers may have benefited from better dispersal ability and increased light. Furthermore, we suggest that reduced logging intensity following certification may have resulted in scarcity of gaps, creating recruitment limitation for timber. Species richness of both ecological groups was highest in natural forests, indicating that loggings have changed the structure of both forests.

11-00 Coffee Break

11:20 Sustainable Management of Neotropical Mountain Rain Forests - An Ecological Experiment -

Sven Gunter; Konrad Fiedler; Robbert Gradstein; Wolfgang Wilcke; Franz Makeschin; Reinhard Mosandl
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The most common strategies for the conservation of highly diverse ecosystems probably is the establishment of protected areas, but it hardly functions well when it is not accompanied by effective administration and control mechanisms. Other options are reforestation measures to reduce the human pressure on the remaining natural forests, and this article focuses on a third complementary strategy for conservation of high diversity forest ecosystems: the sustainable management of natural forests. This strategy could especially be very effective in buffer zones of National Parks with high human pressure but it requires a profound understanding of ecological processes. Liberation techniques of valuable trees are common silvicultural tools worldwide, anyhow, the feasibility of these techniques for tropical mountain rain forests is almost unknown. In this study we analyse the ecological effects of experimental liberation measures on 13 hectares of permanent plots around the Estacion Cientifica San Francisco in South Ecuador.
The abundance of valuable timber trees in the study area is relatively high, but the population structures and growth of many potential crop species have to be considered as rather unfavourable for sustainable forest management. It is shown that liberation techniques can enhance the growth and the natural regeneration of some selected potential crop species, and thus improve the preconditions for economically sustainable management systems. In an interdisciplinary approach it is demonstrated that logging intensity had a significant effect on the beta-diversity of moths but only slight effects on further selected ecological parameters like forest structure and alpha-diversity of the remnant stand, epiphytes and moths. Furthermore it is shown that the water and nutrient fluxes are not significantly affected by the logging intensity. Starting from first results of the experiment, it is discussed if silvicultural treatments can be a tool for sustainable management and conservation of Andean rain forests.

11:40 How sustainable are tropical forest managements in Amazonia?
Jochen Sch¦_ngart
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jschoen

The sustainable management of tropical forests is a promising way to protect the multiple functions and services of ecosystems and to guarantee the use of timber resources for the future. A key-indicator for a sustainable forest management is the wood increment of tree species. Timber resources in Central Amazonian non-flooded upland forests (terra firme), nutrient-rich (varzea) and nutrient-poor (igapo) floodplain forests are managed by selective logging (polycylic systems) with cutting cycles of 25-30 years and an minimum logging diameter (MLD) of 45 cm. However, these time and diameter limitations are estimations or legal restrictions rather than being derived from scientific data. We modeled wood growth parameters from timber species of terra firme, igapo and varzea forests using tree-ring analyses. Cumulative diameter growth curves indicate periods between 13 years and 237 years to pass over the MLD of 45 cm. But volume growth models indicate that timber species reaches their highest volume increment rates at diameters above 45 cm. We define species-specific MLDs at diameters when timber species reach their highest current volume increments. Cutting cycles, estimated as the mean passage time through 10-cm diameter classes until reaching the MLD, indicate large variations between tree species and also between different forest ecosystems. Tropical forest managements are ecologically not sustainable, because they do not differentiate between the growth behaviors of the timber species. Forest management concepts must therefore be species-specific and site-specific to guarantee a sustainable timber resource management and the maintenance of the ecological services.

12:00 Effects of selective logging on the abundance, regeneration and short-term survival of Caryocar costaricense (Caryocaceae) and Peltogyne purpurea (Caesalpinaceae), two endemic timber species of southern Central America
Quesada Mauricio; Lobo Jorge Arturo; Barrantes Gilberth; Fuchs Eric; Castillo Marvin; Quesada Ruperto; Solis Silvia; Maldonado Tirso
Centro de Investigaciones en Ecosistemas, UNAM, Mexico; Escuela de Biologia, Universidad de Costa Rica; Escuela de Biologia, Universidad de Costa Rica; Department of Plant Biology, The University of Georgia, Athens, USA; Escuela de Ingenieria Forestal, Instituto Tecnologico de Costa Rica; Instituto Tecnologico de Costa Rica; Centro de Investigacion en Ecosistemas, UNAM; Instituto Tecnologico de Costa Rica
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In this study, we determined the effects of selective logging on the abundance of two tropical timber species with a restricted distribution, Caryocar costaricense and Peltogyne purpurea. We conducted a census of adult tree densities for these species on 94 selectively logged sites located in a tropical rain forest on the Osa Peninsula, Costa Rica. We compared the abundance of juveniles and seedlings for both tree species on 11 logged and unlogged sites. In addition, we analyzed the growth and mortality rates of adult trees of P. purpurea in a 4 ha permanent plot that was selectively logged once in 1992. Both species presented a heterogeneous density distribution over the Osa Peninsula and the highest density of both species is located in the region of the highest logging activity. For both species seedling abundance was greater in unlogged areas, while juvenile of trees C. costaricense were more abundant in logged areas. The density

of P. purpurea adult trees remained constant 15 years after selective logging but the density of trees 10-30 cm dbh decreased in the same period. We predict that recurrent 15 year cutting cycles of 50% of the adult population, as it is practiced by conventional logging in Costa Rica, may lead a significant reduction of the main reproductive individuals, decreasing the regeneration of the populations already affected by logging and fragmentation.

Ecology Evolution and Conservation of Arthropods. Part I

Room 8: Enrique Shuls (Second Floor)
Building: Colegio Primitivo de San Nicolás de Hidalgo
Wednesday July 18

10:00 Parsimony Analysis of Spider Distributions in the Caribbean
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Phylogenetic analysis is used to determine the evolutionary relationships among different species but these methods have recently been expanded to analyze the relationship among geographic units (islands) based on the species (characters) that each island possesses. This method, called parsimony analysis of distributions, has the potential to reveal geographic affinities of different islands to one another and to potential continental source pools of species based on the constituent species. This method can be used to compare biological colonization to hypothesized geological models of island formation and can be used to examine the relative vagility and establishment success of different taxonomic groups. In 2001, Trejo-Torres and Ackerman analyzed the distribution of orchids in the Caribbean and found that their distributions were governed more by ecological and physiographic factors. I conducted a parsimony analysis of spider distributions to examine the biogeography of spiders in the Caribbean archipelago in order to compare the factors affecting distribution in a group of organisms very different from orchids. A matrix of 1154 spider species on 41 islands and three continents was used as character data to conduct a parsimony analysis on the islands. General results confirm expectations of biogeographic models of island hopping followed by speciation with islands closer to continental source pools appearing as more ƒ?oancestralƒ?? than islands farther from continental source pools. This pattern differs from the ecological/physiographic causes invoked for orchids. This result is probably related to differences in the resource requirements for establishment of different organisms after initial colonization.

10:20 The use of different methods to sample the bee fauna (Hymenoptera, Apoidea), a study in the Araucaria Forest in Santa Catarina, Brazil.
Krug Cristiane; Alves-dos-Santos Isabel
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Bees are an important constituent of the ecosystems owing to their role as pollinators of many plant species. The fauna of bees of the Araucaria Forest in Brazil remains poorly known. This work aims to reduce this gap. A survey of the bee fauna was performed along the border of a forest fragment in the district of Porto UniÆo, in Santa Catarina, southern Brazil. Samples were made monthly between October/2005 and October/2006 with hand nets directly from flowers, along with three types of traps: chemical baits, trap nests and pan-traps. A total of 1711 bees were captured belonging to 164 species, distributed in 5 families of bees that occur in Brazil. From the total 1339 bees of 130

species were sampled with sweep netting, 346 individuals of 72 species were collected in pan-traps, 24 bees of 9 species were caught in the trap nests and two specimens of one species were sampled with baits. At most 48 species were common to two or more sampling methods. Dialictus, with 27 species, was the most representative genus in the area. The exotic Apis mellifera was the most abundant species, representing 49.6% of the sampled bees, followed by Dialictus sp.11 with 3.2%. The melittophilous plants account for 98 species, with Asteraceae and Lamiaceae representing the most important families. The results show evidence of a seasonal pattern of activity and the importance of the use of complementary methods to survey the fauna. The composition of the bee fauna was similar to many inventories performed in the Araucaria Forest, with Halictidae the most diverse family followed by Apidae. The conservation of wild bee populations, and concomitantly the pollination services performed by these animals, depends on the maintenance of the forest fragments and less use of insecticides in cultivated areas.

10:40 Fuzzy set in the evaluation of the conservation state of the land use systems in the Occidental Amazonia, using beetles (Scarabaeidae) as bioindicators

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The knowledge concerning the changes of ecosystems due to the different land use standards is essential for the sustainable development strategies of agro-systems and it allows the establishment of norms based on ecological information which will be able to greatly increase the conservation of biodiversity. A new methodology, the Theory of Fuzzy sets, allows to deal with complex systems like the ambient systems and the subjectivity inherent to them, through linguistic variables and fuzzy algorithms. The objective of this work was to create a model for evaluation of the ambient conservation of different land use systems in the Occidental Amazonia, which supplies conservation indices between zero and one hundred. For such aim the beetles of the Scarabaeidae family (dung beetle) were used as bioindicators, due to its sensitivity to ambient changes and abundance, questionnaire answered for specialists in beetles and through the applicatory generated by the Fuzzy Rule-Based System (FRBS). As result we got the following order of land use systems conservation: primary forest, new secondary forest, rural regions, old secondary forest, agroforest and pasture. This applicatory has as advantages: to use not just one linguistic variable (wealth of species), but others (number of insects and relative abundance) simultaneously, to supply numerical values that allow mathematical calculations complementing other bioindicators, and incorporate in its indices not only sample figures, but also the subjectivity of the human observer. This is another tool that, together with other technologies, will be able to assist to understand how forest species react to the anthropic pressure and which are the ecosystems less affected by the agricultural technologies used for the man.

11-00 Coffee Break

11:20 Rapid spatial turnover of invertebrate communities within habitats: Implications for planning protected areas in Amazonian terra firme forests

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Understanding spatial patterns of biodiversity is essential for planning protected areas that encompass as many species as possible. Although the importance of conserving a variety of habitat types is now widely accepted, the need to protect many large areas of a broadly-distributed habitat class such as Amazonian terra firme forest is currently debated. For example, focusing on several well-studied taxa may lead to the prediction that most species are widespread within primary terra firme forests.

I sampled dung beetle communities in many habitat types in montane and lowland forests in Peru (205 species and 77,000 individuals). Species composition changed distinctly across habitat types, disturbance regimes, and with elevation, even at very small spatial scales. More surprisingly, community similarity within one widespread habitat class, lowland primary terra firme forest, declined rapidly with increasing distance ($R2 = 0.94$, $P < 0.001$), predicting complete community turnover every 700 km. Small geographic range sizes for poorly studied taxa such as invertebrates suggest that conserving Amazonian biodiversity requires a more comprehensive approach than is currently employed.

11:40 NATURAL HISTORY AND CONSERVATION OF THE BRAZILIAN OIL-COLLECTING BEES

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There are about 330 species of bees that use oil collected from flowers to feed the larvae and to surface the brood cells, they belong to the Melittinae (Melittidae), Ctenoplectrini, Centridini, Tapinostapidini and Tetrapedini (Apidae). From these groups the last three tribes are exclusively from the west hemisphere and specially diverse in the Neotropical region. Oil-bees have modifications on the legs or sternum (Tapinotaspoides) to sample, manipulate and transport the oil. These structures are usually correlated with the different type of elaiophores (the oil secreting glands): epithelial or trichomatic. It is estimated that more then 1800 plant species of 8 families offer floral oil as resource, being Malpighiaceae the most important. In this study I present results of the nesting process of some oil collecting bees and discuss the needs required to guarantee their existence. The oilbees are most solitary, but some nest aggregated. The ground nesting species use flat soil or banks (like Epicharis, Monoeca, Lanthanomelissa), and there are some that use nest of termites and ants (like Ptilotopus), or wood pre-existing cavities (like Tetrapedia). Parasites are usually cleptoparasite bees like Coelioxys, Coelioxoides, Mesoplia, Mesocheira, Protosiris, Paraepeolus that usually oviposite inside the brood cell and their larvae (with sharp mandibles) kill the host egg or larvae. Other nest parasites are Mutillidae, Chalcidoidea and Meloidae. The reduction of the Dufour*ƒ*?Ts gland in some oil-collecting species is assumed to be related to the use of floral lipids to surface the brood cells, which would replace the secretion of the Dufourï‹s gland. Indeed some species hold a small gland like Tetrapedia diversipes, which the gland occupies only 2.2% of the metasomal size. The lack of place to nest and the specific preferred plant (for oil and pollen) are probably the most important reason for the decline of the bee populations in Brazil.

12:00 Low beta diversity of ambrosia beetles (Coleoptera: Curculionidae: Scolytinae and Platypodinae) in lowland rainforests of Papua New Guinea

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One of the major questions in contemporary ecology is, to what extent is the structure of organismal communities shaped by stochastic processes such as dispersal, or determined by the community history and habitat variation. To assess the effect of geographical distance on insect species turnover when all other environmental variables are constant, we sampled ambrosia beetles (Coleoptera, Curculionidae: Scolytinae and Platypodinae) from three sites on a 1000 km long transect in lowland rainforests in northern Papua New Guinea. At each site we sampled standardized volume of trunk, branches and twigs from three artificially killed individuals of four tree species: Artocarpus altilis, Ficus nodosa, Leea indica, Nauclea orientalis. With the help of trained indigenous people, we sampled 12,751 ambrosia beetle individuals in 85 morphospecies. The number of species collected at individual sites approached statisticaly predicted total number of species. There is no correlation between community similarity and geographical distance. Communities from different sites appear nearly identical when faunal similarity is measured by abundance-based indices. Monte Carlo test using null distribution supports the hypothesis that our samples came form a single community of ambrosia beetles, regardless of geographical distances between them. Canonical analysis identified tree parts as more important predictor of ambrosia beetle community composition than host species or site. All three variables, however, explained little variability, suggesting that habitat and geographical distribution of ambrosia beetles is driven mostly by stochastic dispersion, uniformly across species.

Human Development and Sustainability. Part I

Room 9: Aristóteles (Second Floor)
Building: Colegio Primitivo de San Nicolás de Hidalgo
Wednesday July 18

10:00 Social networks: tying the community knots for managing biodiversity
Chaudhary Pashupati
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In every society people tie together to fulfill a variety of sociocultural and economic needs, forming complex networks among individuals and households. Such social networks aid the continuous exchange of goods (e.g. seed, grains, land and capital) and services (e.g. labor and information) among people. Strong social network is essential for fostering social harmony, mutual trust, collective action, and fairness and equity. Despite this fact, this issue receives very little attention from scientists and organizations working in biodiversity conservation. Even many patrons of ƒ?~coexistenceƒ?T and ƒ?~community-based conservationƒ?T approaches lack proper foresight to internalize this issue in their work. Many of them also lack scientific understanding on how to analyze social network and how the information could be used for conservation planning.

Social network analysis tool has been developed by agricultural scientists, who implicate this technique as a tool to analyze the relationship among people and identify key (nodal) persons for operating breeding activities and technology dissemination. The tool employs multistage snowball sampling and sociometric survey techniques to assimilate relational data among households. Despite its consequences beyond agrobiodiversity conservation activities, social network issue has remained either overlooked or disregarded in cross-disciplinary scientific communities. It is imperative to make scientists aware of the subject and its methodological issues. More importantly, it is important to demonstrate how social network analysis can be useful for planning and managing conservation work.

I propose to introduce a social network analysis tool and technique using examples from seed network analysis and discuss its implication for other biodiversity conservation work. I will present some examples of real networks and sub-networks and discuss how certain people play key role in such networks. Role of social network in information and knowledge transfer and implications of network analysis study for strengthening social capital and planning conservation activities will be discussed.

10:20 Evolving participatory frameworks for reconciling conservation and livelihoods in India
Rai Nitin; Krishnan Siddharth; Setty Siddappa; Kavitha A.; Kannan Ramesh; Thomas Samuel; Joseph Gladwin
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Current rates of biodiversity loss are high. Conservation strategies to mitigate these losses have often resulted in constraining access of local communities to forest resources on which they are heavily dependent for their livelihoods. This has resulted in conflicts between state and communities that are unraveling conservation gains. Evidence suggests that involving local communities has long-term benefits for conservation. We selected five forest sites with differing tenurial arrangements to explore the social, ecological and institutional conditions necessary for conservation of biodiversity alongside the use of forest resources. Through an interdisciplinary approach we have obtained information on a) the forest and non-forest resource use profile and socio-economic status of households dependent on the landscape, b) the ecological condition and the ecological response to resource use, and c) the institutional arrangements for equitable and sustainable livelihood approaches. This understanding allows us to explore how a participatory system of conservation might be evolved to reconcile conservation and livelihoods in protected areas. In Biligiri Rangaswamy Wildlife Sanctuary for example, the existence of people*ƒ*?Ts institutions, a synergy between the state and civil society and a rigorous ecological research programme have enabled an environment for participatory conservation. Through the provision of health, education and development services, civil society institutions have empowered indigenous Soliga tribals. This empowerment is currently being channeled responsibly towards conservation. We believe that local democratic institutions and strong government support are prerequisites for any participatory programme. The results of our inter-disciplinary effort will inform policy change that will internalize participatory strategies at all levels of forest governance and biodiversity conservation.

10:40 Amazonian Protected Areas for Sustainable Use Monitoring Program: a participative proposal

Marinelli, C.E.; Carlos, H.S.A.; Batista, R.F.; Roh¦«, F.; Waldez, F.
Secretaria de Estado do Meio Ambiente e Desenvolvimento Sustent vel do Amazonas-SDS; Secretaria de Estado do Meio Ambiente e Desenvolvimento Sustent vel do Amazonas-SDS; Secretaria de Estado do Meio Ambiente e Desenvolvimento Sustent vel do Amazonas-SDS; Secretaria de Estado do Meio Ambiente e Desenvolvimento Sustent vel do Amazonas-SDS; Secretaria de Estado do Meio Ambiente e Desenvolvimento Sustent vel do Amazonas-SDS
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The Amazonas State (Brazil) encompasses the biggest continuous protected area of tropical forest in the world, with 97% of its area composed by natural environments. However, due to socioeconomic issues, the problem with the occupation and sustainable exploitation of this region is even bigger. Although protecting areas is one of the most efficient forms to guarantee the conservation of those places, the creation and implementation of a reserve, solely, will not, necessarily, assure its success. It is important to establish an institutional system for natural resource and biodiversity monitoring, allowing, in that way, the monitoring of the influence of anthropic pressures on those resources, making it possible to evaluate the degree of integrity of those protected areas. Our aim is to develop a participative monitoring system, of simple execution and low financial cost. The local inhabitants must be the main executors of the data collection, being trained to use maps and field equipment and to execute monitoring

activities. There are five groups of monitors: interviewers (animal and plant extraction), wildlife monitors (game species census), turtle nesting monitors, fishing monitors and fishing boats traffic monitor. The data collected are sent to SDS technicians for their validation, insertion in a database, spatialization (GIS) and analysis. The data generated will be applied in natural resource management plans. As a consequence, the system is expected to arrange extractive activities, fortifying the productive chains and promoting nature conservation by involving the local people and showing to them the benefits of conserving the resources found in their surrounding environment.

11-00 Coffee Break

11:20 Biodiversity conservation and human development in Costa Rican mountain forests

Criado Juan; Marin Melissa; Diaz Mario; Palacio Dolly
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Costa Rica is recognised at world level because of its compromise between development and conservation of biodiversity. With an extension of 51.100 km2, it is holding an extensive proportion of the Earth biodiversity, currently estimated around 5 %. Environmental policies in Costa Rica are focused in keeping its global position as a mega-diverse country, linking conservation issues with human development necessities, such as the special support of eco-tourism and carbon storage and fixation initiatives. Moreover, the recent Mesoamerican Congress on Protected Areas (2006) addressed the need of conducting research linking biodiversity and poverty alleviation in the region. The study area belongs to the Talamanca Mountains, one of the highest biodiversity and endemism areas of the world. The research considers Los Santos Forestry Reserve (59.972 ha), which includes the Biological Reserve Cerro Las Vueltas and the recently created Los Quetzales National Park. Our objective is to determine the relation between biodiversity conservation and human welfare of communities, using an innovative set of social and biological indicators. The hypothesis considers that a good conservation status of the forest is positively correlated with an equal access of necessary conditions to improve human welfare. We use indicators of the structure of the forest related to frugivorus birds as functional biodiversity indicators, due to their key role in tree seed dispersal in tropical mountain forests. Social indicators are based in organizational participatory network and sinergical satisfactors of human needs. This interdisciplinary study is developing a new methodology to analyse the relationship between conservation and human development in a high biodiversity area and will also contribute to a better understanding of complex interactions between nature and society. This research is partially supported by the Ministry of Foreign Affairs and Spanish International Cooperation Agency (MAE-AECI) under the Doctoral Program on Natural Sciences for Development (DOCINADE).

11:40 Communitarian training for monitoring activities inside sustainable Use protected areas from Brazilian Amazon

Marinelli Carlos Eduardo; S. A. Carlos Henrique; F. Batista Romulo; Waldez Fabiano; Roh¦« Fabio

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The Monitoring Program of Biodiversity and Natural Resource Use in Protected Areas of Amazonas State - ProBUC - is an initiative from Amazonas State (Brazil), which aims to continuously evaluate the level of threat of the protected areas within Amazonas. One of the programs key principles is the involvement of the residents of local communities, not just in the development of the monitoring system adapted specifically to each protected area, but also in the data gathering, the evaluation of these data, and in the development of management proposals. Local community residents participated in a structured training course to prepare them to undertake monitoring activities. Courses were held at the Sustainable Development Reserve of Uacari, and (through collaboration with CNPT/IBAMA Federal Government) at the Extractive Reserve of M,dio Juru . The training courses took place over 10 days (totaling 80 hours). The course focused on both theory and practice, examining the importance of planning the use of natural resources and the role of the communities in biodiversity conservation. The workshops began with a discussion about the conservation and management of protected areas in the Amazon. Later, the participants were divided into five groups according to their specialty, including interviewers (animal and plant extraction), wildlife monitors (game species census), turtle nesting monitors, fishing monitors and boats traffic monitors. Training covered the interpretation of maps, equipment use, the organization of information, interview protocols and techniques, the accomplishment of fauna censuses and educational support to promote community involvement activities in the reserve. At the end of the course 66 of the participants (95%) were approved for the proposed work during a final evaluation.

12:00 Sierra del Divisor, Peru: Biological and Social Inventory, Conservation, Indigenous Peoples, On-going Threats

Moskovits Debra; Vriesendorp Corine; Schulenberg Thomas; Alverson William; Rojas Moscoso Jose-Ignacio
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In 1996, Sierra del Divisor was identified as a priority area in the Peruvian conservation plan (Plan Director). In August 2005, The Field Museum and its Peruvian and Brazilian partners conducted a rapid biological and social inventory of the region. Sierra del Divisor is an isolated mountain range within the Amazon characterized by moderately high diversity and a high concentration of rare and range-restricted species. Voluntarily isolated indigenous peoples (Iskonawa and Kapanawa) live in the southern and central portions; outside the area are 20 villages. Local residents value their forest-based lifestyle and share a common vision of protecting the areaƒ?Ts natural resources. Overlapping proposals by conservation groups, indigenous peoples, and large-scale commercial enterprises cover the region. In September 2005, more than a dozen

conservation and indigenous organizations joined forces to surmount the relentless threats to the region (mining, oil, illegal logging, legal vulnerability of indigenous reserves). In April 2006, the Peruvian government declared Sierra del Divisor a ƒ?oZona Reservadaƒ?? (1.48 million ha), a temporary designation setting the area aside for conservation. In December 2006, new oil concessions were granted in Sierra del Divisor. Oil exploration represents the greatest, fastest growing threat to biological and cultural conservation in Peru. In December 2004, oil concessions covered 13% of the Peruvian Amazon. Since December 2006, oil concessions now cover 70% (48.5 million ha) of Amazonian Peru, including 9 protected areas and 10 indigenous areas.

Plant physiological Ecology. Part I

Room 10: Manuel Altamirano (Second Floor)
Building: Colegio Primitivo de San Nicolás de Hidalgo
Wednesday July 18

10:00 Tree species functional types in a tropical wet forest: delimitation and relationship to taxonomic richness and local rarity
Salgado-Negret Beatriz; Finegan Bryan; Casanoves Fernando
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The value of the plant functional ecology approach to understanding vegetation dynamics and ecosystem processes is widely accepted, but its the application in species-rich tropical forest remains challenging. We delimited plant functional types (PFTs) among tree species of tropical wet forest in northeastern Costa Rica, and determined the distribution of taxonomic species richness and locally rare species (n/ha < 1, >= 10 cm dbh) across the PFTs. Permanent sample plot (PPM) data from 13-16 yr measurement periods (individuals >=10 cm dbh in thirteen 1.0 ha plots) in selectively logged forests were analysed. For 317 tree species, five functional traits were assessed: dispersal mechanism, pollination mechanism, sexual system, height range (H) reached by adult trees (all from secondary information) and absolute annual diameter growth rate (AGR, from PPM data). Cluster analysis delimited five PFTs using H and AGR; the reproductive traits did not contribute to clear groupings. PFTs were more uniform internally with respect to H than to AGR, though there was a marked tendency towards faster AGR with increasing H. PFT-3 - mid and upper canopy tree species with moderate to fast growth ƒ?" was the most species-rich, followed by PFT-2 - midcanopy species with slow growth. After exclusion of understorey species where local rarity can be a methodological artifact, the proportion of locally rare species differed significantly among the PFTs (chi-squared), being greatest in PFTs 2 and 3 and lowest in the remaining groups, of canopy and emergent species. Our functional classification is being refined with more information on AGR, and leaf and stem traits. However, this initial analysis suggests a regional flora shaped by high natural turnover rates but in which slow growth to a midcanopy position is a successful strategy, while pointing to the functional characteristics that may be associated with local rarity.

10:20 Phenological responses of forest trees to natural canopy gap formation
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We investigated the influence of natural gap formation on the reproductive phenology of forest trees in a semideciduous forest from South Brazil. We compared: (i) the intensity of

flowering (flower buds and open flowers) and fruiting (immature and mature fruits) between trees neighbor to gaps (NG) and trees not neighbors to gaps (NN) before and after the gap formation; (ii) the proportion of trees NG and NN flowering and fruiting after the gap formation, considering just the trees that have not reproduced before the gap formation; (iii) the intensity of response to gap formation between understory (UT) and canopy trees (CT); and (iv) the relationship between the gap size and the intensity of flowering and fruiting before and after gap formation, considering just the trees NG. Observations were carried out biweekly from 2000 to 2004, and the creation of gaps occurred due to a storm on September 11, 2002. The intensity of phenological response did not differ significantly between trees NG and NN, even when considering the canopy position. The proportion of trees reproducing just after the gap formation did not differ between NG and NN trees. We found a greater proportion of small than larger gaps, and a slight correlation between gap size and the intensity of phenological response after gap formation. Although small gaps did not change significantly the tree phenological responses, we suggest that an increase in the frequency and intensity of storms, as predicted in the climatic change scenario for South Brazil, may lead to the formation of larger gaps, strongly affecting the forest tree phenology. Financial support: FAPESP; Fellowships: FAPESP (LFA) and CNPq (PM).

10:40 Causes of inverse leafing phenology in Bonellia nervosa (Theophrastaceae)

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The two main hypotheses that have been invoked to explain inverse leafing phenology in tropical dry forest plants are the ƒ?olight limitation hypothesisƒ?? and the ƒ?oescape from herbivoryƒ?? hypothesis. In this study we tested these hypotheses in the tropical dry forest tree Bonellia nervosa (Theophrastaceae). The study was conducted in the tropical dry forest of northwestern Costa Rica in Santa Rosa National Park. To determine how seasonal changes in light availability are associated with phenology of this species, we monitored leaf production, survival, and life span, as well as flower and fruit production of 36 adult plants for a period of 1.5 years. Changes in light availability were monitored using hemispherical photographs. Leaves of six randomly selected branches per plant were marked and monitored every two weeks to measure the cumulative loss in leaf area. To analyse pre-dispersal seed predation we collected 15 fruits per plant and counted the total number of healthy and damaged seeds, as well as the type of seed predators. Leaf, flower and fruit production occurred during the first part of the dry season (November to February). Leaf flushing and leaf shedding showed high synchrony, and leaf numbers were related to light availability. Maximum leaf production coincided with peaks in radiation during the middle of the dry season (February). The cumulative herbivory were concentrated on young leaves, which lost an average of 36.77% of their area. Seed predation in mature fruits was 42%. These results show that the inverse phenology of B. nervosa is consistent with the ƒ?olight limitation hypothesisƒ?? but not with the ƒ?oescape from herbivoryƒ?? hypothesis. Previous studies have shown that decreasing day length induces the highly synchronous emergence of flower buds in deciduous tropical dry forest tree species, but this is the first study reporting induction of leaf flushing by declining photoperiod.

11-00 Coffee Break

11:20 Respiration from coarse woody debris in an old-growth tropical rain forest, Costa Rica
Schwendenmann Luitgard; Ghebray Tesfay
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Although the carbon balance of tropical forests is likely to play a big role in climate change, it is still poorly understood. Coarse woody debris (CWD) is an important component of the carbon stored in tropical forests. At La Selva Biological Station, Costa Rica, CWD contains ca. 33 % as much carbon as in the live trees aboveground. Respiration from decomposing CWD in tropical forests has been found to produce large CO2 emissions to the atmosphere. The objectives of our study were (1) to quantify the carbon transfer through respiration from CWD, (2) to evaluate which abiotic and biotic factors (wood density, CWD temperature and CWD moisture, nutrient and lignin content) control CWD respiration rates and (3) to compare the magnitude of coarse woody debris respiration rates with other CO2 efflux rates in an old-growth tropical rain forest (La Selva Biological Station, Costa Rica). Coarse woody debris was classified into three decomposition categories (sound, partially decomposed and fully decomposed). Respiration from CWD was measured using closed, dynamic chambers connected to an infrared gas analyzer. Per unit bole surface CO2 efflux ranged between 2.0 æmol/m2/s (partially decomposed) and 2.8 æmol/m2/s (sound). Coarse woody debris classified as sound (0.53 g/cm3) had a higher wood density than partially (0.40 g/cm3) and fully decomposed (0.30 g/cm3) pieces. We did not find any significant correlation between respiration of CWD and abiotic factors (wood temperature and moisture). Although not significant, respiration rates were negatively correlated with lignin:N ratio. In this old-growth forest, respiration from CWD (per unit area) is higher than respiration from living woody tissue (stem respiration; 1.34 æmol/m2/s). Soil respiration rates at range between 2.8 to 3.6 æmol/m2/s. Thus, coarse woody debris is an important carbon component in this old-growth forest.

11:40 Light competition between pioneer species early in secondary forest succession in Vietnam
van Kuijk Marijke; Anten Niels
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In tropical regions secondary forest regeneration is often hampered by invasion of shrubs, grasses, lianas or herbaceous plants. It is believed competition for light plays an important role in this context. We analysed the relation between biomass allocation, light capture and photosynthesis for three pioneer species, Mallotus microcarpus, Mallotus paniculatus and Macaranga denticulata and a shrub, Melastoma candidum. The latter is known to inhibit regeneration (Starr et al, 2003).
First we analysed these species in a 5-year-old stand. Then we clear cut and burned the area and non-destructively followed morphology, light capture, photosynthesis and growth of seedlings of these species in time.
In the 5-year-old stand, the tallest species, M. microcarpus, and the shrub had similar, relatively low, light capturing efficiencies. M.denticulata was most efficient in increasing

daily light interception and daily photosynthesis with height and M. paniculatus achieved the greatest height gain with an increase in biomass.
Right after germination, the species already had very different strategies to compete for light. However, M. microcarpus showed the highest increase in height, biomass, daily light capture and daily photosynthesis in time. Other species were able to persist by, for instance, increasing SLA and thereby LAR with tree height and in time. Melastoma successfully competed by placing leaves in a favorable position and thus increasing light capture and by having the highest light use efficiency (photosynthesis per unit of absorbed light).
Apparently interspecific differences in height and light interception that occur during the first 6 months of succession largely determine the size hierarchy that develop during the subsequent five years and this suggests that early dominance is associated with traits that confer rapid height growth during the seedling phase.

12:00 Light incidence and its effects on the understory vegetation in tropical rain forest edges.

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Edge creation modifies the patterns of light incidence on the understory. Using hemispherical photographs we assessed the incidence and heterogeneity of light (diffuse and direct radiation, and mean sunfleck) and its relationship with the abundance, richness and biotic damage of seedlings in forest edges and interiors at Chajul, Chiapas, Mexico. Diffuse and direct radiation percentage were very variable and did not differ between habitats. However, the coefficients of variation suggest that forest edges are more homogeneous than interiors for diffuse radiation. Sunfleck surveys suggest that edges had less light microenvironments important for forest regeneration. The relationships between light availability, richness and abundance of seedlings varied between edges and interiors. The increase in light availability was related to an increase in damage by pathogens. The incidence of light had differential effects on herbivory depending on habitat type. Finally, these results confirm the importance of examining changes of resource availability at forest edges to better understand the edge effects on forest regeneration.

Ecology & Conservation of Birds. Part II

Room 6: Sala 2 (Second Floor)
Building: Centro Cultural Universitario
Wednesday July 18

14:00 MODELING SEASONAL DISTRIBUTION OF LILAC-CROWNED PARROT IN THE CENTRAL WESTERN STATE OF MICHOACAN, MEXICO
Ortega Rodriguez Juan Manuel; Moterrubio Rico Tiberio Cesar; Cancino Murillo Ramon
Facultad de Biologia, UMSNH; Facultad de Biologia, UMSNH; Facultad de Biologia, UMSNH
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The Lilac-crowned Parrot (Amazona finschi) is an endemic species that presents its distribution along the Pacific coast in Mexico. The species has been extirpated locally in many areas due to habitat loss and illegal pet trade. The species is listed as threatened in Mexico and soon will be listed as endangered by the Mexican Official Norm. Due to the species critical situation our aims included to generate estimates of the species potential distribution under three distributional scenarios: a general model, and two seasonal models, one for the breeding season and another for the non-breeding season. Additionally, we evaluated land cover types, and biodiversity conservation areas with a GAP analysis for each modeling scenario. Distributional records were obtained from intensive field surveys during the 2001-2006 period. We used the GARP algorithm to project the geographic representation of the species ecological niche. All models presented high predictive accuracy. The species two seasonal models differed in area predictions, the distribution estimated for the non-breeding season represented the 19.6% of the state, whereas for the breeding season it represented 14.8% of the state, and the difference were statistically significant. The larger potential distribution was predicted for tropical dry and tropical deciduous forests combined. The second natural vegetation class was pine-oak forests. Agricultural lands and pasturelands present an alarming proportion of the species potential distribution projected by GARP. The species distribution in Michoacan may represent between the 6% and 11% of the species global distribution. No significant presence of officially protected areas covers the species potential distribution. This analysis have three important components: 1) It is the first time that GARP is used to model a species seasonal distribution, 2) the models are based on recent and intensive field surveys, and 3) the use of rigorous methodology for model building and validating which included GARP.

14:20 Influence of climatic variability on reproductive output of Lilac-crowned Parrots in tropical dry forest: results of a 12 year study
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Climatic variability may influence reproduction of insectivorous birds in arid environments. However, few studies have determined the impact of climatic variability on the

reproduction of fruit or seed eating birds, or those which nest in the dry season. In a 12 year study, from 1996ƒ?"2007, we determined reproductive output for 111 Lilac-crowned Parrot (Amazona finschi) nests in tropical dry forest of western Mexico. Clutch size varied significantly between years with a high mean clutch of 3.3 eggs/female in 2000, and low mean clutch of 1.7 and 1.8 eggs/female in 2005 and 2006 respectively. Mean yearly clutch size was significantly related to the amount of precipitation prior to the breeding season. Nestling survival also varied significantly between years as a result of brood reduction through starvation of later-hatched nestlings, creating inter-annual fluctuations in reproductive output which was related to fluctuations in rainfall. Variety of nestling diet differed significantly between years, with diets being more varied during years of greater precipitation. Nestling growth also varied between years with nestlings exhibiting faster growth rates during years of greater precipitation and food availability. First-year survival after leaving the nest for 68 radio-marked parrot fledglings was 73% (CI: 53%ƒ?"94%), and all mortalities occurred within 5 weeks postfledging. Lilac-crowned Parrots produced an average 0.97 fledglings on an investment of 2.4 eggs, though postfledging mortality resulted in a final productivity of 0.71 independent young/egg-laying pair. Inter-annual fluctuations in precipitation resulting from the El Ninoƒ?"La Nina weather cycle may limit parrot reproduction in tropical dry forest, influencing clutch size, nestling growth, nestling diet, reproductive output, and postfledging survival. A number of threatened parrots occur in seasonally dry forests, with populations of threatened species in dry habitats being vulnerable to the impacts of climatic variability and habitat fragmentation.

14:40 Nest and breeding behavior of the Citreoline trogon (Trogon citreolus)
Vega Rivera Jorge H.; Valdivia Talia; Vega Debora
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The Citreoline trogon (Trogon citreolus) is and endemic species associated to the tropical deciduous forest of the pacific lowlands. This trogon is one of the few species of birds that constructs cavities on active arboreal termitaria for nesting; however little is known about its natural history. During three years, we studied the nesting biology of this species and monitored the movements and behavior of juveniles through radio telemetry in the Chamela-Cuixmala Biosphere Reserve, in Jalisco, Mexico. The reproductive activities of T. citreolus spans from middle June to middle October, which coincides with the rainy season. All the nests we located were in active arboreal termitaria. Male and female participate in the construction of the nest, incubation, and care of the nestlings. Reproductive success was 34%, coinciding with other studies made with trogons, but contrasting with birds that nest in cavities. Young fledge at 15 ƒ?" 18 after hatching; 37% of juveniles monitored died within 28 days of leaving the nests. Young started foraging by themselves at 25 days after leaving the nest, but some young were seen being feed by its parents at 32 days. During this period, the young were 120 m (ñ 78 m, SD) from they nests. Independence from the parents occurred at 40 ƒ?" 55 days after fledging. Two juveniles were re-located at 0.9 and 1.7 km within the reserve and then disappeared.

15:00 Coffee Break

15:20 Seasonality and origin of dietary protein in Neotropical arid zone birds inferred from stable isotope analysis.

Gonzalez-Carcacia Jose A.; Nassar Jafet M.; Herrera M. L. Gerardo; Martinez Helios M.
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Seasonality in abundance of food sources in temperate and tropical biomes affects feeding strategies of animal populations present in them. With increasing frequency, stable-isotope analyses are being used to investigate trophic patterns and diet sources in species assemblages. This technique is also appropriate to examine the way seasonal fluctuations in food sources affect the species*f*?T feeding habits. In the tropics, this approach has been employed in a limited number of dietary studies focused on bat and bird assemblages in wet and dry forests. In this work, we determined stable-isotope composition (13C/12C and 15N/14N) in whole blood or feather samples of 26 resident avian species in a xeric habitat of northwestern Venezuela, during two continuous years. Our main goal was to quantify seasonal variations in the origin of assimilated protein. From carbon isotopic composition we can deduce the relative contribution of C3 and CAM food sources in the diet. Stable-nitrogen isotope composition can be used to determine relative contribution of plant versus animal sources of protein. Most species either presented an intermediate degree of dependence between C3 and CAM sources or their relative contribution changed seasonally. Only in Leucippus fallax and Tiaris bicolor assimilated carbon was mainly of CAM origin during both dry and rainy season. In contrast, Saltator coerulescens had a marked dependence on C3 plants over the entire study period. Dietary protein in the majority of species had a mixed origin, coming from both plants and insects. However, in 10 species, assimilation of protein of insect origin increased during the rainy season. These species included Mimus gilvus, Melanerpes rubricapillus, and Xiphorhincus picus. Our study suggests that dietary protein accessible to birds in tropical xeric environments has a mixed origin, with insects becoming more important during the rainy months.

15:40 Ecological and Geographic Analysis of the Asian Nuthatches (Aves: Sittidae)

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Development of a broad comparative base of information on phylogeny, geography, and ecology would greatly illuminate i) the role of historical factors and current climate in determining species' distributions, ii) the processes by which current biological diversity evolved, and iii) the importance of this understanding in forecasting species' responses to future climate change. Ecological niche modeling can offer novel insights into the interplay between ecology and geography in evolving lineages. We explored distributions of Asian nuthatch species in ecological and geographic space. Nuthatches have diverse and interesting distributional patterns; they occur throughout the Northern Hemisphere, but are most diverse in southern Asia, where 15 of the 24 species occur and where the lineage is thought to have evolved. A quarter of the nuthatch species are listed as threatened and the status of several Asian species is poorly understood. Our results offer a first step toward a more synthetic view of nuthatch evolution and biogeography. Geographic patterns of Asian nuthatch species richness based on hypothesized actual distributions showed a dramatic focus in a narrow east-west band corresponding to the

forested parts of the Himalayas and a clear mid-elevation focus. The relationship between niche breadth and niche volume was positive but the accumulation of distributional area (niche volume) tapered off with additional environmental combinations (niche breadth). We found a clear negative relationship between potential range filling and montane habit, indicating that montane distributional characteristics limit species' distributional potential.

16:00 Cytogenetic study as a tool for the reintroduction programme of Aburria jacutinga (Aves:Cracidae) in Rio de Janeiro city, Brazil.

Nogueira Denise Monnerat; Verona Carlos Eduardo; Souza Lucia Moreno; Quaresma Larissa; Freitas Andrea de Andrade Rangel
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Recent studies show that Cracids are the most endangered avian family in the Neotropical region. Here, we publish for the first time, the karyotype of Aburria jacutinga, one of the species classified as vulnerable to extinction. Six individuals, selected for a reintroduction progamme in Rio de Janeiro city, Brasil, where the species is considered extinct, were studied. A reproductive female was included in the analysis to confirm the morphology of the W sexual chromosome. The mitotic chromosomes were obtained by the direct culture of the young feather pulp (Sandness 1954), with modifications. The chromosomes were stained with 3% Giemsa in phosphate buffer, pH 6.8 and examined at a 100x magnification. The description of chromosome morphology was based on Levan et al. (1964). The diploid chromosome number found for A. jacutinga was 2n = 84. Chromosome pairs 1 and 2 were submetacentric and the other four pairs of autosomes were acrocentric. The Z chromosome was submetacentric, comparable in size with the fourth chromosome pair, and the W chromosome was a small metacentric. The analysis of the karyotype of the six individuals, first classified as three couples, showed that they were all males and therefore, three individuals had to be replaced for three females to proceed with the reintroduction plan. The karyotype found for A. jacutinga was similar to that described for the few Cracid species studied until now. Considering the reintroduction projects developed nowadays to preserve this endangered family, we suggest that the cytogenetic analysis must be employed for the other species still not studied, to increase our knowledge of the genetic diversity of this group. It is also important to study indiduals from different populations, to investigate the occurrence of chromosome polymorphisms, to prevent reproductive failure and loss of biodiversity due to inappropriate reintroductions.

Forest Management and Selective Logging. Part II

Room 7: Miguel Hidalgo (Second Floor)
Building: Colegio Primitivo de San Nicolás de Hidalgo
Wednesday July 18

14:00 Regeneration of an endangered timber tree species after harvesting in southeast Mexico
Lopez-Toledo Leonel; Martinez-Morales Mariana; Burslem David; Martinez-Ramos Miguel
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Logging gaps were sampled to determine the regeneration of Guaiacum sanctum in a semi-dry forest dominated by this species. Guaiacum sanctum is an endangered timber tree species listed on CITES Appendix-II and is currently logged only in Mexico. At Ejido Pich Forest Reserve in the Central Yucatan Peninsula three 20 x 15 m plots were established in gaps immediately after logging. They were divided in three areas: roots, crown, and a less disturbed area at the margin of the gaps. Three plots in closed canopy forest were also established as controls. Differences in seed and seedling density and growth between within-gap zones and closed canopy forest have been examined for two years. Seeds of G. sanctum were widely distributed in gaps and closed forest, with a density of 1.6 + 0.3 seeds m-2 (mean+/-SEM) at the end of the wet season. Seedling density declined from 116+/-25 100 m-2 immediately after harvesting to 109+/-12 100 m2 after 18 months, but seedling mortality and recruitment were higher in the closed canopy forest than in gaps. Conversely, the growth of seedlings*ƒ*?T height, crown area and leaves were greater in gaps, especially under intermediate light conditions beneath the debris formed by the branches of the harvested tree. In a supplementary experiment under laboratory conditions, seed germination was higher in dark (74%) than in light treatment (29%), which provides a potential mechanism for the greater seedling recruitment in closed canopy forest. Seedling density of other species was similar between gaps and understorey, but seedling recruitment was higher in gap, especially for species such as Cedrela odorata. These preliminary results suggest that the current logging regime has limited impact on the recruitment of Guaiacum sanctum seedlings and that there is sufficient regeneration of this species to maintain its long-term persistence in logged forest under current conditions.

14:20 Changes in forest structure and diversity in polewood forests of Quintana Roo, Mexico
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The demand for understory tropical forest trees has grown considerably over the past decade in the Mexican state of Quintana Roo. Local Maya communities have responded to an emerging market for small diameter tropical trees (5-35 cm dbh) as polewood in the

construction of touristic huts and buildings in the expanding tourism sector of the Cancun-Tulum corridor. Communities have begun to harvest polewood from local forests at a precipitous rate, despite growing concerns for the impact of such actions. In order to explore the ecological impacts of the removal of polewood from forested areas, I explored changes in tree diversity and forest structure along a harvesting gradient in a community forest in the central part of the state. I used a sub-sampling regime to collect diameter at breast height, bole length, and total height of standing trees in areas that had been harvested for polewood and compared them to nearby areas not affected by polewood harvest. Although preliminary analysis of collected data reveal the diversity of trees between harvested and non-harvested areas is not significantly different, harvested areas contain less medium (5-15 cm dbh) and smaller trees (<5cm). In addition, trees left standing in harvested areas are usually those that do not meet the criteria for polewood, i.e. are branched or crooked. These data confirm my initial hypothesis that the removal of small diameter tropical trees as polewood has considerable ecological implications for forest development. Recommendations for adaptive co-management must be considered if these consequences are to be avoided.

14:40 Trade-offs among timber production, fire susceptibility, and carbon sequestration in Bolivian semi-evergreen moist forests

Blate Geoffrey Blate
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Managing tropical forests involves trade-offs because not all values can be simultaneously maximized. I assessed the trade-offs among timber production, fire susceptibility, and carbon sequestration in a seasonally dry forest in lowland Bolivia subjected to four silvicultural treatments of increasing intensity aimed at achieving sustained timber yields (STY). By quantifying treatment effects on fuel loads, vegetative cover, dry down rates of 10-hr fuels, and fire spread, I found that management intensity had little effect on fire susceptibility, although fires that do occur would likely be more severe due to increases in 1000-hr fuels. The modest trade-offs between timber management and fire susceptibility resulted primarily from the fact that this forest is fire prone for about 130 days per year even in the absence of logging. Using a simulation model called SYMFOR to project the likely effects of the silvicultural treatments on future timber yields, forest structure and composition, and biomass, I found that none of the treatments came close to achieving STY, although the intensive management treatment came closest. Neither forest structure nor species composition changed appreciably over two cutting cycles (60 years) in any of the treatments. Although securing STY in these forests probably will require more intensive silviculture, the ensuing trade-offs for biodiversity, timber, carbon sequestration, and other ecosystem services pale in comparison to the trade-offs resulting from forest loss. Increasingly, fire threatens to undermine the goal of maintaining productive forest for both timber and carbon with a full complement of biodiversity. Fire prevention must complement silviculture treatments to achieve sustained yields if tropical forests are to serve both production and conservation goals.

15:00 Coffee Break

15:20 Tree Species Richness and Composition 15 years after Strip Clear-Cutting
Rondon Xanic J.; Gorchov David L.; Cornejo Fernando
Department of Botany, Miami University, Oxford, OH 45056; Department of Botany, Miami University, Oxford, OH 45056; Proyecto Castanales, Puerto Maldonado, Peru
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Strip clear-cutting (or Palcazu Forest Management System) is a natural forest management system that has been proposed as a sustainable alternative for timber extraction in tropical rain forests. As part of an assessment of the sustainability of this system, I evaluated recovery of tree basal area, species richness, and composition after 15 to 16 years of regeneration on two strips cut in 1989 in Jenaro Herrera, Peru. Timber stocking was also assessed in the strips. I further assessed the effects of silvicultural thinning in both strips. The strips recovered 58% to 75% of their original basal area and 45% to 68% of their original tree species richness. Although both strips recovered more than 40% of their original composition, a few commercial species with low basal areas regenerated and pioneer species with high basal areas remained dominant. Silvicultural thinning in 1996 reduced the abundance of pioneer species in the strips. Half of one strip was harvested by deferment-cut rather than clear-cut; regeneration here had greater abundance of commercial species and lower abundance of pioneer species. These findings challenge the ecological sustainability of the strip clear-cutting system. Regeneration of few commercial trees as well as low stocking of larger commercial stems questions the economic viability of this system.

15:40 Effects of a historical fire event on the tree diversity of an Amazon lowland rainforest
Horchler Peter J.
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An unusual local dominance (appr. 4 ha) of a late pioneer tree species (Goupia glabra, Goupiac.) has been observed in a lowland rainforest in the upper Orinoco region (Estado Amazonas, Venezuela). This tree species dominance, together with charcoal frequently recored in the uppermost soil horizon, indicates an extensive disturbance by a fire event dating back at least 80 years. Field data were collected and analyzed to assess the long-term effect of this fire on tree species diversity. In ten 400 mý plots scattered inside and outside the disturbed area all trees with dbh ƒ%¾ 1 cm were recorded. To estimate the impact of the fire event relative to other factors on tree diversity, environmental variables such as elevation, soil texture and spatial location were recorded for each plot. Correlation and multiple regression analysis revealed that current tree alpha diversity is little affected either by the fire or by the environmental variables recorded. The dominance of Goupia glabra, and hence a reduction in overall alpha diversity, is evident only among old trees (dbh ƒ%¾ 10 cm). Current beta diversity, however, is little affected by the historical fire but clearly by other environmental variables indicating the effects of ground and surface water level fluctuations caused by periodic flooding of the adjacent rivers. Furthermore, there is a weak but significant effect of the geographic distance between the plots on beta diversity.

16:00 Phylogeography of Brazil-nut tree (Bertholletia excelsa, Lecythidaceae): evidence of human influence on the species distribution.

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One of the most important economic nontimber forest products of the Amazon region is the Brazil-nut (Bertholletia excelsa, Lecythidaceae). Native stands of Brazil-nut trees (castanhais), aggregations composed by hundreds up to few thousands trees found in the nonflooded Amazon forest, are long thought to owe their origins from pre-Colombian Amerindians. However, there are no update clear evidences based on the distribution of genetic diversity of the species regarding to human influence in the irradiation of the castanhais throughout the Amazon region. Here we report a phylogeographic study of B. excelsa in the Brazilian Amazon based on diversity of the chloroplast genome (cpDNA) using PCR-RFLP, sequencing, and microsatellite markers. Our results revealed no variation upon six non-coding cpDNA regions analysed by PCR-RFLP (3) and sequencing (3) across populations up to 2,800 km away. These findings contrast with the cpDNA polymorphisms found in other Lecythidaceae species among sample sites at local scales. Microsatellite analysis based on variation at eight variable chloroplast loci identified 21 unique haplotypes among 116 individuals from eight B. excelsa widespread populations. An analysis of molecular variance (AMOVA) however revealed no significant population structure at the cpDNA microsatellite loci with 93% of the genetic variation found within populations. The lack of polymorphism and/or any phylogenetically informative intraspecific variation in the chloroplast genome over such large geographical range suggests a recent irradiation of the species across the Amazon. These findings contrast with the high population divergence and structuring expected if B. excelsa irradiation was based on the short-distance seed dispersal promoted by its sole disperser Dasyprocta spp. (agouti). Meanwhile, our results reinforce the putative role of Amerindians in the current distribution of this tree species economically important for the forest dwellers. (rgribel@inpa.gov.br).

Ecology Evolution and Conservation of Arthropods. Part II

Room 8: Enrique Shuls (Second Floor)
Building: Colegio Primitivo de San Nicolás de Hidalgo
Wednesday July 18

14:00 Paper Wasp Brains: Neural Mirrors of Ecological Strategies and Social Organization
Molina Yamile; Harris Robin; O'Donnell Sean
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In insects, brain organization often reflects ecological demands as well as behavioral strategies. Eusocial paper wasps are excellent models for testing relationships between behavior, ecology, and neuroanatomy. First, tropical paper wasps species exhibit a wide range of social complexity and diverse ecologies, allowing for comparative analysis of the evolution of brain/behavior associations. Second, within colonies, genetically similar nest mates can play divergent behavioral roles, resulting in differential exposure to the environment as well as nest mates. Little is known about whether differences in CNS design are associated with caste differences in behavior. We quantified the volume of targeted brain regions of queens and workers from several Neotropical paper wasp genera. We asked whether disparate life histories within, as well as between, species would be reflected in the relative size of neural structures. Specifically, we predicted that the reduction in reproductives*f*?T behavioral repertoire and limited exposure outside of the nest in more socially complex societies would be associated with reduced neural tissue in queens relative to workers. Between species, brain organization may not only reflect the demands of different ecological strategies, such as open versus closed nests, but also the type of caste determination used in colonies. We present results of caste comparisons and species comparisons which suggest that brain/behavior relationships have evolved alongside ecological specialization and social complexity in Neotropical paper wasps.

14:20 Landscape patterns of honeybee production in Puerto Rico in response to climate change
Delgado Diana; Galindo-Cardona Alberto; Restrepo Carla
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Honeybees provide invaluable ecosystem services that range from the production of honey and wax for human consumption, to the pollination of plants in natural and managed ecosystems. In recent years there has been ample evidence for bee declines worldwide, and little is known about the direct and indirect effects of climate on this pattern. Here we examine island-wide patterns of honeybee production in Puerto Rico and ask (1) What is the relationship between honey production and climate? and (2) How honey yields may change under future scenarios of climate change in the island? To answer these questions we used data on honeybee production obtained on a bi-annual basis by the Department of Agriculture of Puerto Rico and interviews with active

beekeepers. Data on honeybee yields (1998-2005) was summarized by municipality and entered in a GIS (Geographical Information System) to generate an island-wide map of honey production. This map together with monthly average temperature and precipitation data and a digital elevation model were used as input variables in BIOCLIM to model patterns of honey yield as a function of climate. Honey yields in Puerto Rico ranged between 0.14 - 4.38 l/colony. The predicted suitable sites for honey production varied among three honey yield categories [low (<0.8 l/colony), intermediate (0.8-2.0 l/colony), and high (>2.0 l/colony)]. The highest predicted honey yields are reported for SE Puerto Rico whereas the lowest for coastal and some mountainous areas throughout the island. With a 2øC temperature increase, the areas that will suffer the greatest impact are those with intermediate (622 km2) and high (308 km2) honey yields. Our data show that the bee industry may be affected in the near future, and suggests that pollination services may also be impacted through mechanisms poorly understood.

14:40 Characterization of leaf gallers of the pepper shaft, Erythrina lithospermae in Gisting â?" Lampung Province, Indonesia

Nukmal Nismah; Widiastuti Endang; Sari Evita
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The objective of this study was to identify and characterize the leaf gall maker insect (leaf galler) of the pepper shaft pest. Characterization of the leaf gallers of the pepper shafts using Erythrina litospermae was conducted in laboratory. Samples of leaf gallers were collected from traditional pepper plantation in Gisting *ƒ*?" Tanggamus District of Lampung Province. Samples then were reared in laboratory for identification and characterization. Identification of the leaf galler was used Borror and White (1971), Erric and Schauff (1998), Boucek (1998), Gates and Alfredo (2004), Pitkin (2004), Heru et al (2006). Some of the characters that were measured were the length of body and forewing, the number of segment and tarsus, the length coxa and the head, the abdominal shape. The results indicated that there were 5 species found, at least, which belonged to Eurytomidae, namely Eurythoma lithospermae, Eurythroma sp and taxon A (unidentified sp). Beside these three, two species were found which belonged to Eulophidae, namely Quadratichus erythrinae and Elasmus sp. The information of identification and characterization of the leaf gallers then is proposed to study the biological control of the insect pest.

15:00 Coffee Break

Human Development and Sustainability. Part II

Room 9: Aristóteles (Second Floor)
Building: Colegio Primitivo de San Nicolás de Hidalgo
Wednesday July 18

14:00 Community involvement in conservation: the case of the Eastern Pacific Green Sea Turtle (Chelonia mydas) in Bahia Magdalena, BCS, Mexico
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Bahia Magdalena, located in the Pacific Coast of Baja California Sur, has been ranked by the World Wide Found for wildlife (WWF) as one of the most important coastal habitats in Mexico needing protection. It is an important feeding and nursery ground for 5 of the 7 sea turtles of the world: Green sea turtle (Chelonia mydas), loggerhead (Caretta caretta), hawksbill (Eretmochelys imbricata), olive ridley (Lepidochelys olivacea), and leatherback (Dermochelys coriacea). All of them have experienced a rapid decrease worldwide in their population size over the last couple of decades. The School for Field studies trough its Centre for Coastal Studies (SFS-CCS) has carried out a monitoring and conservation program for the species present in the area since 2000. C. mydas is the most abundant species in Bahia Magdalena and consequently the most threatened due to local consumption and by-catch, additionally to natural death. The population and distribution patterns of this species were assessed in four estuaries throughout the bay between September 2000 and December 2006. Sea turtle were captured, tagged, measured and released according to standard protocol applied since 2000. A total of 462 turtles were landed with 150 recapture events. The greatest number of green turtles per unit of effort was observed at San Buto (0.3611). The turtle morphometrics showed that the local population is predominantly composed by juveniles (mean Straight Caparace length= 53.2 cm -64.2 cm). Throughout the study period after 2001, a decrease in number of green turtle captures per unit effort is evident, indicating a decline in population density in the bay. This has serious consequences for conservation and recovery efforts in the region.

14:20 Indigenous Maya appropriation of nature in the northeastern Yucatan peninsula: lessons for biodiversity conservation and sustainable development
Garcia-Frapolli Eduardo; Toledo Victor; Martinez-Alier Joan
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Yucatec Mayas*f*?T appropriation of nature is based on a combination of practices that are implemented on a balanced way (self sufficiency and market-oriented) and on multiple spatial scales, creating a variety of managed landscape mosaics. This paper analyzes the appropriation of nature implemented by Yucatec Mayas living in a protected area (PA) in the northeastern Yucatan peninsula, Mexico. By applying an ecological-

economic approach to ecosystems appropriation, the paper aims at showing the multiple-use rationality behind the diversified system of agroforestry management carried out by locals. The paper reveals the ecological, economic and social conditions under which the multiple-use strategy is developed in addition to the spatial distribution where the activities are implemented, giving the empirical evidence for developing the multiple-use strategy scheme for the PA. The study shows that households in the PA manage a total of 5 land use units (milpa, homegardens, secondary forest, aquatic systems and old-growth forest) where they implement 13 different activities. Following this strategy, 49% of households*ƒ*?T labor force is dedicated to use-value activities (milpa, homegardening, fishing, hunting, and gathering of firewood and wood for house construction), representing 47% of the total economic value of the system, while 51% of the labor force is directed to market-oriented activities (goods, temporary work outside their communities and environmental services, such as ecotourism), representing 53% of the total economic value. Yucatec Mayas from this PA have implemented a strategy of natural resources management based on the diversification of activities. Some are traditional, passing from one generation to the next, but others are fairly new and are improving by trial and error. The rationality in the implementation of these activities is driven by the maximization of available options and not by the maximization of profits.

14:40 A computer system for soil assessment to determine land suitability in a rural community in Mexico

Murguia Miguel; Munoz Daniel; Hernandez Mayra; Lopez Francisco
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Objectives
This work exposes the construction of a computer system to assess soil properties to determine land suitability for agricultural zoning of pitahaya cactus (Hylocereus undatus) crop, in a rural community of Mexico, as an alternative to the firewood collecting as the main means to obtain economic inputs to traditional farming systems.

Method
The computer system has two main components: 1) a database of physical and chemical soil characteristics (implemented in MS Access), and 2) its processing by means of a rule based system, that stores and applies knowledge of experts to generate the assessment for land suitability useful to the plot stakeholder (implemented in the Prolog programming language).

Results
The information is processed in four stages, increasing the level of abstraction and the agricultural context in each one. The main report includes a picture of the plot and a summary of data collected in each step, that allows tracing the construction of the assessment in a simple form.

Conclusions
The database, including the queries and reports, constitutes an adaptable shell for land suitability assessment for other crops. This tool stores and processes information and knowledge allowing their direct and expeditious use that facilitates communication

between research groups and the inhabitants of rural communities.

Acknowledges
We want to thank the people of Colonia San Martin community, who asked for doing the assessment and have been shown a serious interest in sustain development. This work was developed within the framework of the ƒ?oMacroproyecto Manejo de Ecosistemas y Desarrollo Humano Universidad Nacional Autonoma de Mexico SDEI-PTID-02ƒ?? project.

15:00 Coffee Break

15:20 Biodiversity and conservation of a sclerophyllous forest in Northern Peru
Aragon Susan; Woodcock Deborah
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How do we conserve biodiversity while at the same time caring about the wellbeing of the rural and indigenous farmers? To answer this question we first have to understand how the ecological processes are carry out in rural landscapes. We studied the plant community close to the Paleontological Forest of Piedra Chamana, located in the District of Sexi, Cajamarca Department, in the Northwestern Andes of Peru. Our objectives were to: a) describe the plant community composition and structure; b) analyze the co-occurrence of the plant species, looking for instances of competition or facilitation; c) assess the various disturbance factors and their effect on the vegetation; and d) evaluate the conservation needs in the area and formulate suggestions regarding measures that would both help to support the rural community and contribute to the forest conservation. We report 119 species in 96 genera and 43 families. We compare the composition and structure of plant assemblages in low and high grazing areas finding that although distinct they share many elements and there are facilitative processes which may help to recover the plant community in degraded areas. The natural vegetation forms a broadleaf sclerophyllous forest with epiphytic components and abundant vegetal cover at the ground level. There is representation of species of dry forest associations as well as elements of more humid forest. The conservation status of this forest is hopeful provided some urgent measures are taken to protect and restore the tree cover, to maintain the biodiversity present and to foster the well being of the peasant communities who depend on the productivity of this forest.

15:40 Urban ecology issues in Australia's wet tropics: opportunities and challenges in a World Heritage Landscape
Turton Stephen
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The Wet Tropics region of Australia is internationally recognised for its outstanding natural heritage values. The region uniquely contains two world heritage areas (WHAs) side by side, the Wet Tropics and the Great Barrier Reef, that are renowned for their high diversity of species and habitats, with both WHAs being considered as global biodiversity

ƒ?~hotspotsƒ?T. Like other regions of eastern Australia, the Wet Tropics has experienced widespread clearing for agriculture and urban development, associated with 'Sea change" and 'Tree change' phenomena. Despite these major landuse impacts, the region still contains large tracts of intact forest and wetlands that have been severely degraded elsewhere in eastern Australia. In recent decades there has been increasing pressure for further agricultural, urban, peri-urban and tourism development in the Wet Tropics and this has provided conservation planners with both challenges and opportunities for sustainable use of Australiaƒ?Ts most biologically complex landscapes. I shall provide an overview of the current status and trends of these ƒ?~contested landscapesƒ?T, and how science can play an important role in underpinning their sustainable use.

16:00 Persistent Organic Pollutants in American oysters and sediment from the Chijol Canaland the Pueblo Viejo Lagoon, Veracruz, Mexico.

Borabe Luz; Sericano Jose L.; Garcia-Murillo Antonieta; Carrillo-Romo Felipe de Jesus
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The Pueblo Viejo Lagoon and Chijol Canal are coastal ecosystems associated with the Panuco estuary. The southern urban region of Tamaulipas, which includes the cities of Tampico, Madero, and Altamira, is located on the margins of this system. The economic and ecological importance of this ecosystem resides in its fishing production as well as in its spawning and nursery areas for fish, crustacean, and bivalves. The state of Veracruz alone provides 49% of the Gulf of Mexico.s production with 40% of the production registered by the state coming from the Pueblo Viejo lagoon. Bivalve mollusks accumulate contaminants both directly from water and by ingestion of those incorporated in phytoplankton, detritus and/or sediment. For this reason, and because of its wide distribution along the coast of the Gulf of Mexico, the American oyster is frequently used as a target species in biomonitoring studies. Thus, the main objective of this study was to assess the spatial distribution and seasonal variation of organochlorine pesticides (OCPs), polychlorinated biphenyls (PCBs) and, polynuclear aromatic hydrocarbons (PAHs) in this estuarine-lagoon ecosystem. For this purpose, oyster and sediment samples were collected during the 2005 rainy and 2006 northern seasons and processed following standard operating procedures (SOPs) in use by the Geochemical & Environmental Research Group at Texas A&M University. Total concentrations of target analytes in oysters were in the order: PAHs (168.4 ng/g)>DDTs (52.8 ng/g)>PCBs (10.7 ng/g). Similarly, the distribution in sediments was 748.4, 1.3, and 0.5 ng/g, respectively. In this study, the concentrations of total PCBs (range: 1.5-21.2 ng/g) and DDTs (range: 5.9-134.8 ng/g) resulted similar to those reported earlier in the region during the International Mussel Watch program (<100 ng/g and <110 ng/g, respectively). Total PAHs, on the other hand, resulted higher (range: 23.3-752.7 ng/g) than those reported in that study (<100 ng/g).

Plant physiological Ecology. Part II

Room 10: Manuel Altamirano (Second Floor)
Building: Colegio Primitivo de San Nicolás de Hidalgo
Wednesday July 18

14:00 Seedling performance of Gilbertiodendron dewevrei under simulated light conditions helps explain its monodominant stands in Central African forests.
Hall Jefferson S.; Saltonstall Kristin; de Paul Medjibe Vincent
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Gilbertiodendron dewevrei forms large monodominant stands across much of Central Africa. Several studies have tested different hypotheses related to its ability to form monodominant stands. We compared growth of recently germinated G. dewevrei seedlings to that of Entandrophragma angolense, a non-pioneer light demander found to perform well across a variety of soil fertility and light conditions, to assess whether competition for light at the seedling establishment stage contributes to its ability to form monodominant stands. Soils for this experiment were very infertile and taken from three different Gilbertiodendron stands. Seedling growth was assessed over a 10 month period at four light levels: full sunlight, light shade, moderate shade and shade. G. dewevrei, a species considered to be shade tolerant and thus not expected to perform well at moderate or high light levels, had a total mass relative growth rate (RGR) twice that of E. angolense in full sunlight (0.24 g g-1 month-1 vs. 0.12 g g-1 month-1). E. angolense out-performed G. dewevrei only under light shade (0.33 g g-1 month-1 vs. 0.25 g g-1 month-1), a level where it is known to exhibit optimum growth. In terms of total mass, G. dewevrei seedlings grown in full sunlight were >10 times larger than those of E. angolense (37 grams vs 2 grams), and almost double those grown in light shade (37 grams vs 22 grams). G. dewevrei seedlings were approximately 5 times larger than those of E. angolense grown in moderate shade and shade treatments. While it might be expected that a shade tolerant species would exhibit less plasticity, the strong performance of G. dewevrei across a broad range of light treatments suggests its ability to colonize gaps contributes to formation of large, monodominant stands.

14:20 Neotropical seedling dynamics: relative contributions of light availability and conspecific seedling and adult densities to mortality in 23 woody species
Vriesendorp Corine; Kobe Richard
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Both gap partitioning and negative density-dependence (Janzen-Connell hypothesis) are widely cited as potential mechanisms maintaining tropical plant diversity. We examined relative contributions of light availability, seedling density, and adult density to seedling mortality of 23 woody plant species at La Selva Biological Station, Costa Rica. From February 2000*ƒ*?"August 2002, we monitored natural recruitment and mortality of seedlings every six weeks in five 1x200m2 belt transects (10,420 seedlings total). For

species with at least 20 individuals, we used survival analysis and maximum likelihood methods to evaluate mortality responses to variation in (i) multiple indices of mature tree neighborhood density, (ii) density averaged over a seedlings*ƒ*?T lifetime (heterospecific, conspecific, total), and (iii) light availability (total transmittance, canopy openness), all at a 1m2 scale. Relative model fits were evaluated with Akaike*ƒ*?Ts Information Criterion and 95% support of model parameter estimates. For most species (18/23), models with one or more factors were better than null models, with significant effects of light availability (9 species), conspecific seedling density (13), and conspecific mature tree neighborhood (12). For all species, probability of mortality decreased with canopy openness, increased with seedling density, and increased with trees within a neighborhood radius, a parameter estimated from the data. There were no effects of heterospecific seedling density on mortality, and once light availability was included, no effects of heterospecific adult density. Twelve species had significant parameter estimates for multi-factor models: light and conspecific seedling density (3 species), conspecific seedling and adult density (3), and all three factors (6). Contrary to expectations under Janzen-Connell, species sensitivity to density was not related to species abundance. Rather, low*ƒ*?"light survivorship (i.e., shade tolerance) co-varied with sensitivity to conspecific density. While negative density-dependence appears quite prevalent, rather than promote species coexistence by constraining populations of common species, instead it appears to exaggerate life-history differences.

14:40 An analysis of the role of water, herbivores and light in determining plant distributions.
Kursar Thomas A.; Coley Phyllis D.; Brenes-Arguedas Tania; Blundo Cecilia; Rivas Gonzalo; Rios Marcos; Lukasik Piotr
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A fundamental goal of ecology is to understand the mechanisms that determine species distributions. Even though rainfall in closed-canopy tropical forests is high, many observations suggest that forest composition is sensitive to seasonal differences in precipitation. We established two common gardens within a rainfall gradient in the Isthmus of Panama in order to separate the effects of drought, herbivory and light as determinants of plant distributions. Seedlings of over 20 species with contrasting distributions in wet or dry sides of the Isthmus were transplanted into both gardens. Their responses to the dry season, herbivores and light were evaluated. Water availability had a strong effect, with greater dry-season mortality on the dry side. Watering treatments did not influence mortality but improved the growth of most seedlings. When directly measured in both larger and smaller seedlings, the rate of leaf damage was greater on the wet side. Caging reduced herbivore damage and seedling mortality but did not affect seedling growth. Pathogens also may be important in determining distribution. During the first six months after transplanting, seedling death (tentatively) assigned to pathogens was pervasive on the wetter site but rare on the drier site. Light significantly correlated with growth rates in the wet, darker site but not in the dry, brighter site. We conclude that light and biotic factors, specifically herbivores and pathogens, represent the most important limits to plant performance in the wetter forest. In contrast, water availability is the most important limitation on the dry side. While sites

clearly differed in selection pressures and the favored adaptations are site-dependent, we also suggest that the relative importance played by each of these factors may differ considerably among species having the same distributions.

15:00 Coffee Break

15:20 Carbon dynamics in the aboveground wood biomass of wetland forests in the Pantanal and Central Amazonia
Sch¦_ngart Jochen; Nunes da Cunha Catia; Warren Coraciara Stadtler Eva; Arieira Julia; Felfili Fortes Caroline; Cezarine de Arruda Erica
Max-Planck-Institute for Chemistry ; Federal University of Mato Grosso; National Institue for Amazon ; Federal University of Mato Grosso; Federal University of Mato Grosso; Federal University of Mato Grosso
jschoen

Tropical forests store large amounts of carbon in the aboveground coarse wood biomass (AGWB), but uncertainty remains regarding their function as significant carbon sinks due to gaps in understanding forest dynamics. For many wetland forest ecosystems undergoing dramatic changes by land-use no estimation of carbon stocks and sequestration is available. In this study we estimate C-stocks and C-sequestration in the AGWB of wetland forests in the Northern Pantanal and forests of the nutrient-rich (varzea) and nutrient-poor floodplains (igapo) of Central Amazonia. Inventory data of 11 ha representing forests of different successional stages growing under varying nutrient status were converted to predictions of AGWB by allometric models using diameter at breast height (DBH), wood density and tree height as independent variables. Carbon sequestration was estimate by growth models based on tree-ring analyses which is a new approach in tropical forest research. Therefore we modeled age-DBH and DBH-height relationships by non-linear regression models. C-stocks (50% of AGWB) of wetland forests varies between 8-101 Mg C/ha in the wetland forests of the Pantanal, 90-115 Mg C/ha in the nutrient-poor igapo floodplain forests and 8-120 Mg C/ha in the nutrient-rich varzea floodplain forests. C-sequestration in AGWB in the Central Amazonian varzea floodplain forests (2.7-8.5 Mg C/ha/year) is higher than in the wetland forests of the Pantanal (0.5-3.1 Mg C/ha/year) and the igapo floodplain forests (1.2-2.0 Mg C/ha/year). Our results indicate that C-dynamics of AGWB vary considerably between wetland forests depending on the nutrient status, the hydrological regime and the successional stage. The differences in forest dynamics of wetland forests have to be considered for their conservation and development of sustainable forest managements.

15:40 Multiple Effects of Cadmium on the Photosynthetic Apparatus of Avicennia germinans L. as Probed by OJIP Chlorophyll Fluorescence Measurements
Gonzalez-Mendoza Daniel; Zapata-Perez Omar; Espadas y Gil Francisco; Santamaria Jorge
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The toxic effects of cadmium on the photosynthetic apparatus of Avicennia germinans were evaluated by means of the chlorophyll fluorescence transient O-J-I-P. The chlorophyll fluorescence transients were recorded in vivo with high time resolution and

analyzed according to the OJIP-test that can quantify the performance of photosystem II. Cadmium-treated plants showed a decrease in yield for primary photochemistry, TR0/ABS. The performance index of photosystem II, PIABS, decreased due to cadmium treatment. This performance index is the combination of the indexes of three independent parameters, (1) the total number of active reaction centers per absorption (RC/ABS), (2) yield of primary photochemistry (TRo/ABS) and (3) efficiency with which a trapped exciton can move an electron into the electron transport chain (ETo/TRo). Additionally, the F0/Fv registered the highest sensitivity to the metal, thus indicating that the water-splitting apparatus of the oxidizing side of PS II is the primary site of action of cadmium. In summary, cadmium affects several targets of photosystem II. More specifically the main targets of cadmium, according to the OJIP-test, can be listed as a decrease in the number of active reaction centers and damage to the activity of the water-splitting complex.

Global Change

Room 11: Erodoto (First Floor)
Building:Colegio Primitivo de San Nicolás de Hidalgo
Wednesday July 18

14:00 Rapid change in Amazonian forest dynamics: effects of climate change?
Laurance Susan; Nascimento Henrique; Condit Richard; Laurance William
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We investigated changes in forest dynamics in intact central Amazon rainforest. Over a 25-year period we conducted 5 censuses of trees (>10 cm diameter-at-breast height) within 20 1-ha plots spanning a 1000-km2 landscape. Based on censuses of >21,000 trees, we calculated annualized mortality and recruitment rates for each plot and stem-growth rates for individual trees. Tree mortality rates have increased significantly since our first census interval (1981-1987). Tree recruitment rates have also increased significantly but lag behind mortality, suggesting that recruitment is strongly influenced by mortality. During the second interval (1987-1991) we observed a spike in mortality rates and a significant decline in tree growth, suggestive of a period of environmental stress for tree communities. Growth rates subsequently recovered and by the latest census interval (1999-2003) were significantly higher than at the outset of the study. Tree biomass increased during the second census, declined in the third (1991) in response to the mortality peak, and continued to rise subsequently. The results of this study support earlier work that has identified trends in increasing tree turnover and biomass accumulation in the Amazon. A number of mechanisms such as past disturbance, inter-annual weather variation, and anthropogenic atmospheric change could potentially underlay these trends.

14:20 Climatic Change and the Amazon Forest Tree Phenology
Morellato Patricia; MoCambite Pinto Antonio
- Universidade Estadual Paulista, Departamento de Botanica, and Plant Phenology and Seed Dispersal Group, Rio Claro, Sao Paulo State, Brazil; INPA - Instituto Nacional de Pesquisas da Amazonia, CoordenaCao de Pesquisas em Silvicultura Tropical, Manaus, B
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We investigated the effects of natural climatic changes on tropical forest reproductive phenology over 39 years and compared the phenological trends between two forest sites, to understand: (i) if the flowering and fruiting patterns are affected by climate changes, especially el nino events, represented by increasing dry season length or severity; (ii) if the climatic changes have an effect on the flowering and fruit production over the years and, (iii) How the observed reproductive phenological trends differ between RFD (an urbanized reserve) and EEST forests? The phenological observations of Amazon lowland forest trees have started in 1965, at Reserva Florestal Ducke (RFD) and, in 1974, at INPA EstaCao Experimental de Silvicultura Tropical (EEST) about 30 km from

Reserva Ducke (Manaus, Amazonas State, Brazil). For each site 500 trees of 100 species were selected and are monitored monthly until today. Phenological patterns at both areas were seasonal, showing a flowering peak during the dry season most of the years. The expected general increase on flowering and fruiting production due to el nino was not observed for Amazon lowland forest trees. The lower rainfall and longer duration of the dry season during el nino years had a positive effect on flowering, but did not increase the proportion of species or trees flowering over the years. However, a strong negative feedback was observed among the drying trends and the proportion of species fruiting at RD over the years, suggesting that synergic factors such as fragmentation and deforestation, concurrently with el nino effects, are reducing the proportion of species fruiting, with implications for Amazon forest ecology and conservation. Financial support and fellowships: CNPq

14:40 Using predictive models of speciesâ?T distributions to evaluate the effects of climate change in Bolivia: conservation implications

Fernandez Miguel; Zambrana-Torrelio Carlos M.; Calderon Javier; Tejeda Wendy; Villanueva Gabriela; Villalpando Gabriela; Hamilton Healy
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Continuing human population growth and habitat degradation and loss has negative effects on biological diversity. Among these threats, climate global change is one of the most important since it will have effects upon biodiversity distribution in the medium and long terms. This is due to the fact that species may respond differently to climate change. Therefore, understanding the effects of climate global change on speciesï distribution is a very important and seldom accomplished task and is necessary to take actions to preserve this biodiversity. We use ecological niche modeling as an approach to address this issue. The MaxEnt algorithm employs climate variables as well as data of species occurrence to predict their geographical distributions. We modified the database of Worldclim ver 1.4 using two climate change scenarios, based on projections published by Intergovernmental Panel on Climate Change, IPCC (2006). These projections predict an increase on temperature between 1.4 and 5.8 Celsius degrees during a 100 year period. We selected five species of mammals: Tapirus terrestres, Mazama americana and Tremarctos ornatus of wide distribution and considered threatened and Tolypeutes matacus and Phyllotis wolffsohni , species of restricted distribution. Using these models we compare the actual and predicted distributions. Our results suggest that the actual protected areas in Bolivia are not enough to protect these species under both climate change scenarios.

15:00 Coffee Break

15:20 Internal nitrogen cycling in tropical forest soils

Arnold Julia; Corre Marife; Edzo Veldkamp
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Nitrogen (N) deposition in the tropics is predicted to increase by several hundred percent in the next decades. The few studies on the impact of altered N-input in tropical rain forests and preceding research in temperate forests suggest that the nutrient status is the key to investigate reactions on increasing N deposition.
The main objective of our study was to quantify internal N cycling of soils in different stages of development and similar soil types, along an elevation sequence present among primary forests in Costa Rica.
To determine gross rates of N transformation we used the 15N pool dilution technique. Injection with 15N, incubation and extraction took place in the field to avoid process changes due to modified conditions.
We measured high initial ammonium (NH4+)- and nitrate (NO3-)-concentrations in an old lowland residual soil compared to alluvial soils nearby, but low gross N mineralization and nitrification rates, especially when compared with the total N content. In the montane forest NH4+- and NO3--concentrations tended to rise with increasing altitude but decreased if seen proportional to the total N content. Both gross mineralization and nitrification increased with altitude, but gross mineralization rates were likely to decrease relative to total N. Net N mineralization rates increased with altitude and also tended to increase if seen proportional to the total N content. The old residual soil showed a relative open N-cycle indicating that this ecosystem is not N-limited, thus losses via leaching or gaseous emission are expected to come along with altered N deposition. In contrast to previous studies, we found that N transformation rates increased along the elevation sequence, leading to higher N availability.

15:40 Spatial variation in solar irradiance and the recruitment of rainforest trees at Khao Yai National Park, Thailand

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Studies of tree distributions at the Mo Singto Forest Dynamics Plot (Khao Yai National Park, Thailand) suggest that the recruitment of some species may be limited by very recent climate change. While large individuals (ƒ%¾ 10 cm DBH) of the wild rambutan Nephelium melliferum Gagnep. (Sapindaceae) are distributed over the entire 30 ha plot, small individuals (< 10 cm DBH) seem restricted to certain areas. N. melliferum seeds appear to be dispersed widely across the site (by white-handed gibbons, Hylobates lar), so we are investigating whether sites lacking saplings have become unsuitable for germination or seedling survival. These sites could have aspects and slope angles that orient them toward the sky, for example, in which case they would receive greater insolation and might be the first to become too hot and dry from climate change. We used models of topographic variation at Mo Singto and the sunƒ?Ts daily trajectory across the sky to compute spatial variation in aspect, slope, and cumulative annual insolation across the plot. Sites occupied by adult and sapling N. melliferum do not differ significantly in aspect, but saplings occur on 11% steeper slopes (so, less-oriented to the sky) with 2% lower annual insolation than adults. The biological significance of receiving 2% less solar radiation each year is unclear, so we will follow with field measurements to determine the differences in ground temperature and soil moisture between sites occupied by saplings

and adults. We will also conduct experiments to evaluate if germination success and seedling survival are lower on slopes occupied by adults, to determine if these higher-insolation sites have become too hot and dry for recruitment in this species.

16:00 Modeling and predicting the effects of global warming on range shifts, biotic vacuums, and mountaintop extinctions in the tropics

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Species turnover (beta diversity) is especially rapid along elevational transects in the tropics, making such transects particularly sensitive to the effects of global warming. For example, the hummingbird assemblages of sites in Costa Rica or Peru separated by 1500 m elevation (less than 100 km map distance) differ about as much as lowland hummingbird assemblages 3000 km apart (Costa Rica and Amazonia). We present a simple, graphical model of the potential effects of climatic warming on elevational ranges, based on the concept of a midpoint-range plot. A single parameter (delta), the elevation change for an isotherm, given a particular amount of warming, characterizes the lower threshold for lowland "biotic vacuums," sets the maximum extent of elevational non-overlap between pre- and post-change ranges, predicts the extent of elevational range contraction of large-ranged mountaintop species, and defines the set of small-ranged mountaintop species threatened with extinction. Recent data from the forested Barva Transect in Costa Rica (3000 m elevational rise over 30 km) illustrate these potential changes. For example, with 3 degrees C increase in mean temperature, about 20 of 565 species of epiphytes, 4 of 82 species of Rubiaceae, and 28 of 739 species of geometrid moths recorded on the Barva Transect would be threatened with mountaintop extinction, assuming no prior or concurrent adaptation to warming. Under the same assumptions, dispersal limitation would threaten extinction of up to 66% of the epiphyte flora, 70% of the Rubiaceae, and 25% of the moth species on the Transect whose post-warming elevational ranges no longer overlap their pre-warming ranges.

Succession in tropical Ecosystems

Room 6: Sala 2 (Second Floor)
Building: Centro Cultural Universitario
Thursday July 19

10:00 Evidence against the intermediate disturbance hypothesis from the dry tropical forests of Old Providence Island, Colombia.
Ruiz Jorge; Fandino Maria Claudia
Universidad Pedagogica y Tecnologica de Colombia y Universidad de La Salle; Instituto de Investigacion de Recursos Biologicos Alexander von Humboldt
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We censused woody flora more than 2.5 cm Diameter at Breasth Height (DBH) in 109 cuadrats of 2 x 50 m that were sampled randomly in the dry tropical forests od Old Providence Island, (13 N, 81 W) SW Caribbean, Colombia. The island is only 22 km square km, and was declared by UNESCO a Man and the Biospehere Reserve in 2000. The archipelago also hosts a national park. For 1982-2000 the island reported a mean annual precipitation of 1584 mm, with a dry period offive months, January through May. We navigated to the selected stands with GPS. Replicates were taken at different age classes along a chronosequence established through remote sensing, i.e. panchromatic orthorectified aerial photos and satellite images, 1944-2005. The intermediate-disturbance hypothesis predicts that biotic diversity will be greatest in communities subjected to moderate levels of disturbance. Our results do not provide support for this hypothesis since they indicate that nonparametric, abundance-based estimators of species richness increase linearly with the age of the stand.

10:20 Patterns of forest succession in northeastern Costa Rica: aboveground biomass, species richness, and species composition in a chronosequence of 30 sites
Letcher Susan G. Letcher
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Secondary forests have ever-increasing abundance and importance in the tropical landscape. Successional forests present special challenges for analysis, since stand dynamics are influenced by forest age, prior land use, and other site-specific factors. I investigated patterns of aboveground biomass (AGBM), species richness, and species composition in 0.1 ha Gentry transects in a chronosequence of 30 sites in northeastern Costa Rica, comprising 23 secondary forest sites (10-42 yr) and seven old growth forest sites. AGBM increased rapidly and predictably with forest age, reaching levels comparable to old growth in 20-30 yr. Estimates of AGBM in the oldest secondary forest sites (30-42 yr) exceeded published estimates for old growth forest biomass in the region. Species richness also increased with age, reaching a level comparable to old growth forests in 30 yr. Species composition varied along the chronosequence. ANOSIM revealed significant differences among some subsets of forest ages, but detected no significant difference between secondary forests >30 yr and old growth forests. In order to incorporate the effects of land use history, I used the amount of time that a site was in

pasture (<1-c.30 yr) as a proxy for the intensity of prior land use. I tested the effects of forest age and land use history in an orthogonal GLM design incorporating only secondary forest sites, with two levels for age (< or > 20 yr) and two levels for land use history (< or > 10 yr in pasture). Age and land use explained 49% of the variance in AGBM and 60% of the variance in species richness.

10:40 Diverging successional pathways â?" recovery from controlled and uncontrolled selective logging of dipterocarp forest

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Recovery from selective logging depends on harvest intensity, damage to soils and residual trees, and the extent to which weeds establish and slow or modify successional pathways. We tested a hypothesis that the rate and mode of recovery from logging is independent of logging damage sustained. We compared stand structure and composition using repeated measurements of permanent plots in areas logged according to reduced-impact logging guidelines (RIL) with areas logged conventionally (i.e., uncontrolled and unplanned, CL) in Sabah, Malaysia. After 12 years, stand stem density and basal area were similar to prelogging levels in RIL areas whereas negligible recovery of stem density and basal area occurred in CL areas. Tree recruitment in CL areas was similar to that in RIL areas but high mortality rates and low growth rates meant that basal area and biomass did not increase over time. In addition, 36% of CL areas were covered by herb-dominated vegetation, compared with only 11% in RIL areas. Recovery in RIL areas is dominated by growth of trees that survived logging, emphasising the value of protecting advance regeneration during harvesting. Light hardwoods, an important group of commercial species, increased in terms of proportional representation in RIL areas, implying that the controlled harvesting intervention increased stocking and future potential timber yields. In contrast, the lack of recovery and degraded structure that currently characterises CL areas suggests that their value for future timber harvests is relatively low. In addition, RIL areas appear to be more valuable than CL areas for the provision of ecosystem services, specifically in terms of forest structure, forest cover, carbon storage.

11-00 Coffee Break

11:20 species dynamics in secondary forests

van Breugel Michiel; van Breugel Paulo; Mendez Bahena Alfredo; Bongers Frans; Martinez Ramos Miguel
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Observations on secondary forests suggest that a limited number of pioneer species, representing a very small sub-set of the regional species pool, dominate the secondary forests within a certain region and age range. We present one of the very few studies that provide quantitative data on patterns of species frequencies and abundance across the secondary forest of a region, using 72 secondary forest plots in southeastern Mexico,

ranging in age from 0.5 to 18 years.

Steep rank-frequency curves demonstrate that only few species are widely distributed across the landscape. Among pioneer species, frequency and abundance patterns differ greatly. Over 75% of the pioneer species occurred in less than 15% of the plots. Only two pioneer species (Cecropia peltata and Trichospermum mexicanum) occurred in ƒ%¾ 50% of the plots. They were also the only species that were relatively dominant (> 10 stems / > 10% of stand basal area) in ƒ%¾ 20% of the plots. Other species were dominant (> 10% basal area) in the plots were they occurred, but never abundant (e.g. Ochroma pyramidale); frequent but never abundant (e.g. Vernonia patens); or locally abundant but with low relative basal area (e.g. Acalypha diversifolia).

Next, the population dynamics of some of these pioneer species was compared, using data from permanent plot studies in young secondary forests on aspects such as seed rain, recruitment, and size ƒ?" and competition regulated growth, and mortality. Even species that had similar life span and maximum stature, and comparable frequency and abundance patterns, differed significantly in these life history aspects.

In order to understand the role of secondary forests in the maintenance of tree biodiversity on landscape scale, we need an integrated approach combining information on patterns of frequency and abundance of species across the secondary forests of a region and their life history attributes.

11:40 STRUCTURE AND COMPOSITION OF SECOND-GROWTH SEASONALLY DRY TROPICAL FORESTS IN YUCATAN, MEXICO

Dupuy Rada Juan Manuel; Collantes Chavez Alejandro; Benavides Rosales Gabriel; Yam Uicab Oscar; Calvo Irabien Luz Maria; May Pat Filogonio
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Seasonally dry tropical forests (SDTF) cover a greater area and are more threatened than their moist counterparts. Most studies of secondary forest succession, however, have focused on tropical moist forest. To achieve sound management, conservation and restoration of SDTF we need to understand the patterns, processes and factors that determine secondary succession. Here we analyze the structure and composition of 8-60 y-old SDTF stands in nine 0.1-ha plots in Yucatan in relation to stand age and soil properties (%OM, pH, N, P, K, CIC, leaf litter). Tree and total basal area was positively dependent on successional age (R2 = 0.817 and 0.767, P < 0.005 and < 0.001, respectively). Abundance of tree seedlings (< 0.2 m tall), shrub and liana saplings (> 0.2 m tall, < 1 cm DBH) and tree juveniles (1 cm < DBH < 5 cm) was also positively dependent on age (R2 > 0.48, P < 0.05 in all cases). For saplings of trees and shrubs, rarefied species density, species diversity, and/or estimated species richness (Chao2) depended positively on soil properties (CIC, N, K, %OM; R2 > 0.497, P < 0.05) but not on age. Rarefied species density and estimated species richness of juvenile trees and lianas also depended on %OM and CIC, and P and pH, respectively (R2 > 0.46, P > 0.05). Abundance of tree and liana saplings depended positively on % canopy openness (R2 > 0.5, P > 0.05). Species composition of all woody life forms in all size classes was more strongly related to the environmental variables than to successional age. Our results indicate that successional age affects basal area, whereas environmental factors,

especially soil properties, influence the diversity and composition of these second-growth SDTF stands. Soil conditions thus merit special consideration in conservation, management and restoration efforts involving these forests.

12:00 Chronosequences may help predict plant community structure and dynamics: the case of a tropical dry forest succession

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Most vegetation successional models have been developed based on chronosequences, using a static correlative approach; scarce research has been conducted on long-term dynamics of the successional phenomenon. This work analyses the parallelism between predicted chronosequence patterns and the forest successional dynamics observed in permanent plots. We used abandoned pasture fields and old-growth forest in a tropical dry region of Western Mexico. We established permanent plots in the next successional stages: 0-1, 3-5, 8-12 years since field abandonment, and old-growth forest, each category with three replicates. We compared composition and structural attributes of the regenerating forest community. We registered seedlings, re-sprouts, and small saplings (shorter than 1 m height), six times, along two years. While the chronosequence analysis showed a sustained increase in abundance, cover, species richness, and diversity with fallow age, the permanent plot data showed high variability in the rates and direction of change of the community variables. The successional changes of dominant species predicted by the chronosequence strongly differed from the observed ones in the permanent plots. For example, while the chronosequence predicted a disappearance of the early dominant Mimosa arenosa during the first three years of succession, such species showed permanence in the long-term. Also, Casearia corymbosa declined in relative abundance in the chronosequence from 8% to 0%, in sites with 3-5 years of succession, but the permanent plot showed a two-fold increase in the same time period. The land use history of each abandoned field and the surrounding matrix of remnant forest seem to play a central role in different successional patterns among sites of same fallow age. Our study showed a poor correspondence between the long-term successional trajectories and the chronosequence predicted patterns. Long-term studies could improve our understanding of patterns, processes, and mechanisms of the secondary succession in abandoned pasture fields.

Phylogeny and Phylogeography of plants

Room 7: Miguel Hidalgo (Second Floor)
Building: Colegio Primitivo de San Nicolás de Hidalgo
Thursday July 19

10:00 Origin and Evolution of Spondias purpurea (Anacardiaceae)
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All crops are derived from wild plant populations. Domestication is the evolutionary process that occurs as humans select and cultivate wild plants; artificial selection and genetic drift associated with the domestication process result in cultivated populations that are genetically and morphologically distinct from their wild progenitors. Mesoamerica is one of the global centers of plant domestication; in addition to corn, beans, and squash, numerous cultivated fruit trees were domesticated from plants growing in the forests of Mesoamerica, including anona, avocado, cas, jocte, nance, mamey, matasanos, and sapote. This study documents the origin and evolution of one of the native tree crops of the Mesoamerican tropical dry forests, jocote (Spondias purpurea, Anacardiaceae). DNA sequence data from the chloroplast (trnG-trnS) and nucleus (pepC IV) are used to delimit the S. purpurea lineage in Mesoamerica. The geographic origins of cultivated S. purpurea populations are identified using chloroplast sequence data and aflp data. The impact of human selection on the amount and structure of genetic variation in cultivated S. purpurea populations is quantified using aflp data. Changes in the ecological characteristics of the S. purpurea distribution are assessed using ecological niche modeling techniques. Results indicate that S. purpurea is a distinct lineage in Mesoamerica. Phylogeograhic analysis of chloroplast sequence data, as well as principal components analysis of AFLP data, provide two independent lines of evidence for at least two geographic origins of cultivated jocote populations from their wild progenitors, one in western Central Mexico and one in Central America. The domestication process in S. purpurea resulted in decreased levels of genetic variation, and increased structure in genetic variation, in cultivated S. purpurea populations relative to wild S. purpurea populations. Finally, human selection during domestication has led to cultivated S. purpurea populations that occupy a wider range of habitats than their wild ancestors.

10:20 Phylogenetic relationships among Inga (Fabaceae) species from Manaus, Amazon, Brazil.
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Inga is a highly species-rich Neotropical genus comprising about 300 species that evolved in the past two million years. Here we present preliminary phylogenetic results for eleven Inga species occurring in Manaus, Central Amazon, Brazil, based upon two non-coding chloroplast DNA regions. Our main objective is to develop a molecular phylogeny of the Inga in order to reveal the evolutionary history of anti-herbivore traits in Inga. Leaves of Inga species were collected at Reserva Ducke and Km 41 BDFFP/INPA reserve in Manaus region, AM, Brazil.Total genomic DNA was extracted following standard CTAB protocol. PCR amplifications of the psbA-trnH spacer and the trnL intron were carried out using universal primers. The amplification products were sequenced using Big Dye chemistry in an ABI 377 Prism DNA sequencer following the manufacturer*ƒ*?Ts instructions. Maximum parsimony analysis was performed for both chloroplast regions (c. 1,000 aligned bp) in a data matrix containing these species and 30 others from elsewhere in the wide Neotropical distribution of Inga. The Manaus Inga species are resolved in several clades, suggesting no evidence for a geographically restricted radiation of Inga species in the central Amazon, and that the Manaus Inga flora has been assembled, in part, by historical dispersal from other regions. These results must be regarded as preliminary because levels of sequence divergence are low, and data from more genome regions are necessary to produce a well-supported phylogenetic hypothesis. Acknowledgements: BDFFP/INPA, Brazil and STRI.(mlemes@inpa.gov.br).

10:40 Phylogeny and introgression in Bornean Dipterocarpaceae

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Genes of one species are not always distinct from those of another species due to either ancestral polymorphism or introgression. This phenomenon is often found in phylogenetic studies involving closely related species. Although obtaining a clear picture of the divergence of closely related species is important for understanding the basic processes by which biological diversity is generated, introgression is difficult to distinguish from ancestral polymorphism with a phylogenetic approach. In this study, we determined nucleotide sequences of five loci from multiple individuals in four closely related species of Shorea, the most species-rich genus in the Dipterocarpaceae. The gene genealogies differed considerably among the loci and showed that the genes of respective species are not monophyletic. To test the significance of introgression, we conducted a recently developed analysis that implements Markov chain Monte Carlo methods for estimating population genetic parameters under a coalescent model with introgression after speciation (the Isolation with Migration model of Nielsen and Hey, 2001). The program revealed low to moderate levels of introgression between some species. Divergence

times among the species were estimated to be 4.3ƒ?"4.7, or 5.7ƒ?"6.2 mya. These estimates of divergence times are older than the estimates from the model without introgression, particularly when there was evidence of introgression. Our analysis suggests that a model without introgression is not adequate to describe the speciation history of the Shorea species, and that introgression affects the gene genealogies, levels and patterns of genetic diversity, and divergence time estimations for the species.

11-00 Coffee Break

11:20 Comparative phylogeography of Caribbean wetland plant species
Rivera-Ocasio Elsie; Rauscher Jason T.; Aide T. Mitchell; McMillan W. Owen
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Spatial patterns of genetic structure at large spatial scales can be used to determine the geographic origin of populations and to infer historical events (e.g., colonization and migration routes). In this study we describe the genetic structure of five wetland plant species (e.g., Avicennia germinans, Laguncularia racemosa, Conocarpus erectus, Annona glabra and Pterocarpus officinalis) across their geographic distribution within the Caribbean using nrDNA and cpDNA. Both markers identified similar patterns within species. The populations of A. germinans, L. racemosa, and P. officinalis clustered into three groups:1) Mexico and Florida populations, 2) Central and South American populations, and 3) Insular Caribbean populations. There was no genetic variation among populations of C. erectus and A. glabra. While similarities in the spatial patterns of genetic variation between some species may reflect a common biogeographical history or common dispersal corridors, the distinct pattern of the other species suggests a complex interaction between different historical and/or ecological processes (e.g., recent colonization, extintinction-recolonization events, and high gene flow).

11:40 Geographic origins and domestication processes in a tropical tree fruit, Chrysophyllum cainito (Sapotaceae)
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The star apple or caimito tree, Chrysophyllum cainito (Sapotaceae), is valued as an ornamental tree and for its large, edible fruits. It has been planted throughout the Greater Antilles, Central and South America. Caimito also occurs as ƒ?onaturalizedƒ?? or ƒ?owildƒ?? populations within many of these regions. The geographic origin of caimito is debated: various authors argue that it is native to the Greater Antilles, and that it was planted across Central and South America only after the Spanish Conquest, while others believe that it is native to parts of mainland Latin America. In Panama it is promoted as a native reforestation species. In this study we document genetic variation in cultivated forms compared to their putatively wild or non-cultivated counterparts using DNA sequence data. These data are used to assess whether or not extant wild populations of

caimito exist, to reconstruct the probable geographic origin of the species, and to test support for the hypothesis that caimito is native to the Greater Antilles and introduced into areas where it occurs in Mexico and Central America. In combination with ethnobotanical interviews and linguistic data, we attempt to reconstruct the history of introduction, cultivation and levels of human mediated selection in different geographic and cultural regions.

12:00 Modeling niche conservation with community phylogenetic distance as a response variable: a model selection approach to the identification of metacommunities
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Molecular phylogenetic analysis of tropical legumes suggests that patchily distributed seasonally dry tropical forests form a dispersal limited metacommunity with a potentially high diversity generating capacity. This is inferred from strong patterns of geographic phylogenetic structure of narrowly distributed clades, each of which may comprise multiple allopatric species. To test this hypothesis, we take a model selection approach. Explanatory variables include geographic distances, from which dispersal limitation can be inferred, and environmental distances (e.g., measures of moisture, altitude, etc.), from which niche assembly can be inferred. Phylogenetic distance as a response variable provides insights into the degree of niche conservation. In contrast, community distance (e.g., Sorensen) as a response provides insights into the relative contribution of dispersal versus niche assembly. A metacommunity may have dispersal limited local communities because of niche assembly. If speciation events are equally likely to encompass all of the local variation within a metacommunity, dispersal limitation will not be evident at the clade level. A simple example that illustrates this approach involves inventory data taken from deciduous and semidecidous forest in Brazil.

The Ecological Role of Ants in tropical ecosystems. Part I

Room 8: Enrique Shuls (Second Floor)
Building: Colegio Primitivo de San Nicolás de Hidalgo
Thursday July 19

10:00 Leaf-cutting ants as ecosystem engineers: Microclimatic gradients in the vicinity of Atta cephalotes nests

Meyer Sebastian T.; Leal Inara R.; Tabarelli Marcelo; Wirth Rainer
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Recent studies in the Atlantic Forest of NE-Brazil revealed, that Atta cephalotes leaf-cutting ants increase drastically (> 8-fold) along the forest edge, to the extent that large forest zones contain ca. 3 nests per ha. Considering that such nests represent forest gaps, we speculated that the effects of anthropogenic forest fragmentation are reinforced by an additional ƒ?omicro fragmentationƒ?? caused by ants. Here we investigated the environmental impact of A. cephalotes colonies by assessing 1) the spatial extension of the associated nest clearings (N=56 colonies) and 2) their impact on the surrounding forest microclimate (N=11 colonies). Diurnal courses of light interception, air temperature, air humidity, and soil temperature were measured using arrays of sensors along transects into the forest (10 points spaced by 3m, starting at the nest center). Soil moisture content was assessed gravimetrically once per day. A. cephalotes colonies maintained nest clearings of up to 150mý in the understory with a significantly higher canopy openness (5.91+/-2.37%) than in ant-free control plots (3.82+/-0.87%). Up to three times as much light reached nests compared with the surrounding forest floor. This was accompanied by higher maximum air and soil temperatures (27.8 vs. 27.4 and 25.2 vs. 23.3øC, respectively). Relative air humidity showed an inverse pattern to air temperature with a lower minimum humidity above nests (55.3 vs. 60.2%). As typical for clearings, parameters showed stronger daily fluctuations above the nest. All microclimatic parameters besides soil moisture changed significantly and for all colonies similarly with distance to the nest as analyzed by regression models. We conclude that A. cephalotes nests and their surroundings represent sites of considerable microclimatic alteration with the potential to influence organisms and biological processes, making these ants true ecosystem engineers. In the light of drastic edge-driven accumulations of leaf-cutting ants this may have far-reaching consequences for neotropical forest fragments.

10:20 Cutting More from Cut Forests: Drastic Edge Effects on Colony Density and Herbivory Pressure of Leaf-Cutting Ants

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Because of the crucial trophic position of herbivores and their far-reaching impact on plant communities it is important to understand how habitat edges influence their abundance and damage levels. For the present study, we assessed these parameters for the leaf-cutting ant Atta cephalotes, a representative of probably the most dominant group of herbivores in the Neotropics. To evaluate edge effects on colony density, we surveyed a total area of 56 ha along 27 transects for A. cephalotes in a remnant of the Atlantic forest of NE-Brazil and estimated the depth of edge influence across 50-m distance zones paralleling the forest edge. To evaluate whether and how edge influences herbivory rate, we quantified the proportion of the leaf material harvested by an adult colony in relation to the available leaf area in the foraging area of edge versus interior colonies. We encountered a total of 43 A. cephalotes colonies, the density of which changed drastically (ca. 8.5-fold) with distance to the edge (i.e. 2.79+/-3.30 ha-1 in the first 50 m versus 0.33+/-1.11 ha-1 in the >50-m interior). Moreover, A. cephalotes colonies located at the forest edge removed about twice as much leaf area from their foraging grounds than interior colonies (14.3 versus 7.8% col-1 yr-1). Depending on the demographic structure of the local A. cephalotes population (i.e. the proportion of adult colonies), the overall herbivory in the 50-m edge zone may reach up to 40% compared to 2.5% in the (>50m) forest interior. In the light of the ever-increasing pervasiveness of forest edges and the significant impact of leaf-cutting ants on ecosystem processes, such edge-driven accumulations of Atta damage may have far-reaching consequences for neotropical forest fragments.

10:40 Ancient human landscape modifications affect contemporary ecosystem functioning: the ecology of an ant-plant seed dispersal mutualism in pre-Columbian raised-field complexes in seasonally flooded savannas of French Guiana

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Much work in ecology today focuses on how current human activities affect ecosystems through changes affecting land use, nutrient cycles, and climate. However, humans began affecting ecosystems long before the modern age. Through raised-field agriculture, pre-Columbian farmers transformed infertile, seasonally flooded savannas in many parts of the neotropical region into productive agricultural land. These ancient earthmoving activities also permanently altered landscapes. In coastal French Guiana, complexes of pre-Columbian raised fields have produced landscapes dotted with thousands of mounds in a seasonally flooded matrix. We studied the functioning in such landscapes of the seed dispersal mutualism between the plant Manihot tristis, which is diplochorous (ballistic autochory followed by myrmecochory) and the ant Ectatomma brunneum. Both the plant and nests of the ant are intolerant of flooding, and in these landscapes both are found only on mounds. Taking advantage of the quasi-experimental setting offered by the regular and periodic nature of ecological heterogeneity in this landscape, we tested the hypothesis of directed seed dispersal by ants to favourable

microsites. We placed diaspores in the matrix during the dry season, mimicking ballistic dispersal away from the mounds. Although mounds accounted for only 36-45 % of the total surface area of the landscape, over 74 % of the diaspores placed in the matrix were carried to mounds; of these, 93 % were transported into ant nests, from which they would eventually be placed in refuse piles, which are highly suitable establishment sites. Several other myrmecochorous plants are also found only on mounds in the study site. Directed seed dispersal is one of many positive feedback loops we have identified that concentrate resources and consumers on mounds, maintaining these features against homogenizing processes such as erosion.

11-00 Coffee Break

11:20 Plant recruitment on inactive nests of the leaf-cutting ant Atta cephalotes in the Brazilian Atlantic Forest

Bieber Ana Gabriela Delgado; Tabarelli Marcelo; Leal Inara R.
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While treefall gaps are known to maintain the diversity of tree species in tropical rainforests, the role of understory gaps created by leaf-cutting ants (Atta spp.) remains mostly unexplored. Atta nests are free from competition, present higher luminosity at ground level and chambers with higher nutrient concentration. Therefore we hypothesized that after a nest becomes inactive, it could turn into a suitable habitat for plant recruitment and growth, especially for particular groups such as abiotically dispersed and shade intolerant species. In an Atlantic Forest area in Northeast Brazil, we monitored changes in the densities of non-adult plants on recently inactive nests (RINs, N=8 nests) and old inactive nests (OINs, N=10 nests) of Atta cephalotes during one year period (December 2004 to December 2005). Nests were compared with nearby plots without any visible disturbance, and non-adult individuals were classified into seedlings, saplings, or poles. Poles were also assigned into functional categories regarding regeneration strategy and seed dispersion mode. Both seedling and sapling densities on RINs (meanñSD: 2.96ñ5.25 and 0.73ñ0.43 inds. m-ý respectively) were less than one third of the densities found on OINs (12.82ñ8.25, 2.58ñ1.14 inds. m-ý) and control sites (9.34ñ7.23, 2.82 ñ 1.51 inds. m-ý). Poles were two times denser in control areas (0.66 ñ 0.36 inds. m-ý) than on both inactive nest types (RINs: 0.25ñ0.16, OINs: 0.30ñ0.18 inds. m-ý). In addition, inactive nests did not present a significantly higher frequency of abiotically dispersed or shade intolerant species than control areas. In contrast to our expectation, inactive Atta cephalotes nests neither are especially facilitating the recruitment of plants nor are more suitable to a specific plant group in this tract of the Atlantic forest. Further studies should investigate the generality of our patterns.

11:40 Consequences of habitat fragmentation in the Brazilian Cerrado to an ant-plant mutualism (Tococa guianensis and Allomerus sp.)

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We studied the interaction between ants and the ant-plant Tococa guianensis (Melastomataceae) in the Cerrado biome region of central Brazil. Plant populations were found in gallery forests and more rarely in grassland areas adjacent to these forests. Of the 238 plants found, 67.2% had obligate ants (mostly Allomerus sp. nov.), 21% had opportunistic ants, while the remaining 11.8% had no ants. Obligate ants were not found in the two transects run in fragmented forests, while in continuous forest (n = 6 transects) they were usually found in > 75% of the plants. In the grassland transect only a few plants had obligate ants, and all of these harbored incipient colonies. Standing levels of herbivory were significantly greater in plants with obligate ants than in the remaining plants (without ants or with opportunistic ants). Moreover, plants with obligate ants have comparatively more leaves than plants without these ants. Furthermore, their leaves had more water, were less tough, and had a lower density of trichomes than the leaves of plants without obligate ants. Experimental removal of Allomerus ants resulted in an increase in the density of leaf trichomes, indicating that the production of trichomes is inducible. Examination of herbarium specimens revealed that Allomerus sp. nov. was present but then disappeared from one the fragmented forests studied (i.e. was locally extinct). The ability of T. guianensis to induce alternative defenses against insect herbivores may help to explain the persistence of viable populations of this ant-plant in the absence of its mutualistic ant partner.

Invasive Species in the Tropics

Room 9: Aristóteles (Second Floor)
Building: Colegio Primitivo de San Nicolás de Hidalgo
Thursday July 19

10:00 African grass invasion in a tropical freshwater marsh: Knowing the invasion process to propose a restoration strategy

Lopez Rosas Hugo; Moreno-Cassola Patricia; Mendelssohn Irving A.
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The integrity of freshwater marshes of coastal areas in the Gulf of Mexico is threatened by the invasion of introduced African grasses. Their use for extensive cattle ranching and their tolerance to flooding make their invasion a serious problem. For this research we evaluated the invasion process occurring in a coastal freshwater marsh dominated by the hydrophytes Sagittaria lancifolia and Typha domingensis (popal-tular) in Veracruz (Mexico) by the African grass Echinochloa pyramidalis. Experimental quadrants mounted in border areas between popal-tular communities and areas dominated by E. pyramidalis showed an important invasion process by the grass. We also planted individuals of the invader species into areas that had not been previously invaded and results showed that native species do not present resistance. An experiment that evaluated interspecific competition between the invader species and the two major native hydrophytes in different hydroperiods showed that the performance of the invader is higher in drier than in flooded conditions. Results also showed that the higher performance is positively correlated with vertical accretion in the marsh. Finally, we evaluated the response of vegetation to experimental disturbances that could eliminate or reduce the dominance of E. pyramidalis in order to propose a restoration strategy. Reduction of E. pyramidalis resulted to be very difficult, although successful results can be obtained if rhizomes are destroyed using soil disked treatments and by increasing the density of certain native species such as S. lancifolia. The use of shade cloth was also found to be successful in eliminating the invader species but the recovery of the native community resulted to be very difficult.

10:20 Restoration attempts through non-native species removal: experimental results from a lowland wet forest in Hawaii

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Resource competition with non-native plant species is one of the greatest threats in

Hawaiian forests today, and is especially true in lowland wet forests, which are only left in remnant patches and are heavily invaded. Despite the recent decline of these forests, little is known about the potential for lowland forest restoration or the resilience of the forests once the obvious threats are removed. To test the effects of non-native species on rainfall interception, plant water use and acquisition, light availability, plant productivity, seed rain, and seed bank dynamics, we established four 100 m2 removal plots and paired controls in a fenced exclosure in a 30 m elevation lowland wet forest on the island of Hawaii. Light availability increased by more than 50% when the non-native species were removed. During dry periods soil water availability was greater in the removal plots, despite the fact that rainwater inputs into the plots were similar. In addition, litterfall inputs in the control plots were double the removal plots, although there were no differences in soil nutrient availability. Tree growth is significantly greater for the native species Psychotria hawaiiensis in the removal plots. In terms of regeneration dynamics, native seed is being produced in both control and removal plots, but the dominant canopy tree Metrosideros polymorpha is establishing only in the removal plots. The seed bank is composed almost entirely of non-native species. Non-native species are clearly having large impacts in this forest in terms of reducing light and perhaps water availability, adding large amounts of nutrients to the forest floor, and persisting in the seed bank. Canopy opening through this passive restoration approach may be required for the continued growth and regeneration of lowland forest species in Hawaii.

10:40 Psidium cattleianum: Ecology and impacts of an invasive tropical tree.

Denslow Julie S.; Uowolo Amanda L.; Purell Melora K.; Yanagida John F.; Zimmerman Naupaka
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Psidium cattleianum Sabine (strawberry guava) is a small tree introduced to Hawaii in 1825 from Brazil and considered one of the state*ƒ*?Ts most disruptive alien weeds. On all the major Hawaiian islands as well as on many other tropical islands in the Pacific and Indian Oceans, nearly monotypic stands of this species infest thousands of hectares of mesic and wet forest. It is a serious threat to native forest ecosystems due to its ability to invade even relatively undisturbed wet forests and form thickets up to 10 m high with dense mats of feeder roots. On Hawaii Island, P. cattleianum infestation impedes Acacia koa silviculture and, because it is a wild host of economically important fruit flies, limits crops grown by Hawaii farmers. We report on studies of the ecology and economics of strawberry guava on Hawaii Island. In lowland wet forest dominated by Metrosideros polymorpha (900 m asl), demographic studies document high rates of population growth through both seedling and sprout recruitment contributing to high local stem densities (>15,000 stems/ha). Density and diversity of native species are inversely correlated with P. cattleianum basal area. P. cattleianum seed banks are ephemeral (< 6 mo), however, with most seed depletion due to rapid germination and seed predation by rodents. The lack of a persistent seed bank suggests that coupling biological control with chemical and mechanical treatments may be able to reduce impacts in target areas. Using Genetic Algorithm for Rule Set Production (GARP) to project the potential range of P. cattleianum on Hawaii Island, we estimated economic impacts on agriculture, silviculture and conservation reserve management. Our data suggest that P. cattleianum has almost reached the extent of its potential range on the island and that actual and potential costs

to conservation, agriculture and silviculture are high.

11-00 Coffee Break

11:20 Inter-population variation in seed germination of Calotropis procera Ait. (Ait.) F. (Apocynaceae) in Brazil

Newton P. U. Barbosa; Lélis A. C. Júnior; G. Wilson Fernandes; Fernando A. O. Silveira

Ecologia Evolutiva & Biodiversidade/DBG/ICB, Universidade Federal de Minas Gerais, MG, Brazil; Ecologia Evolutiva & Biodiversidade/DBG/ICB, Universidade Federal de Minas Gerais, MG, Brazil; Ecologia Evolutiva & Biodiversidade/DBG/ICB, Universidade Federal de Minas Gerais, MG, Brazil; Curso de CiÝ¦ncias Biol¢gicas/FCBS, Centro Universit rio UNA. Rua Jos, Cl udio Rezende, 80. 30455-590, Belo Horizonte, MG, Brazil faosilveira@terra.com.br

Biological invasion is the second most important factor driving biodiversity losses. The giant milkweed, Calotropis procera, is an invasive species from tropical Africa and Asia that has now naturalized in South America. It is now under an active process of habitat occupation in Brazil perhaps owing to the ongoing global changes that involve increasing habitat temperature, habitat disturbance and low precipitation events. We compare the germination of C. procera seeds collected from different populations in Brazil. Mature fruits were collected in six populations from three Brazilian states: Pernambuco [Serra Talhada (ST), Petrolina (PE)], Minas Gerais [Itacarambi (IT), Montes Claros (MC), Uberaba (UB)] and Sao Paulo [Ilha Solteira (IS)]. Apparent viable seeds were set to germinate in Petri dishes and set to incubation at B.O.D. chambers at constant temperatures of 30§C at a 12-hr photoperiod, and complete darkness. Mean germination time (MGT) was calculated for all populations. For each treatment, 25 seeds were placed in each Petri dish (n=6) and data were compared through a factorial ANOVA followed by Tukey*ƒ*?Ts test (×ñ =0.05). Both population (F=72.29; p < 0.0001) and light (F=9.82; p < 0.01) influenced seed germination. Germinability ranged from 96.3 ñ 3.17 at IS to 43.3% ñ 14.75 at UB. Germination at ST, IT and IS were significantly higher than at MC, PE, and UB. Although light did not influence seed germination in some populations, MGT was lower under dark, meaning that seeds germinated faster compared to the 12-hr photoperiod. Lower germination at UB could be a result of endogamy since this population is comparatively smaller than the others. Nevertheless, geographical distance did not correlate with germinability, meaning that germination was not influenced by distance. Results indicate that maternal effects during seed maturation may be more important than geographical distance.

Ecology and Conservation of Amphibians and Reptiles

Room 10: Manuel Altamirano (Second Floor)
Building: Colegio Primitivo de San Nicolás de Hidalgo
Thursday July 19

10:00 Edge effect on tropical herpetofauna: The influence of seasonality and edge orientation
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Anthropogenic activities are transforming tropical environments into seminatural landscapes where between-patch isolation and within-patch edge effects modify in a great instance animal ensemble structure and movements. We evaluated seasonal and edge-orientation effects over abundance and species composition of amphibian and reptiles in a highly fragmented tropical rainforest at Los Tuxtlas, Veracruz ƒ?" Mexico. We sampled 14 ecotones,each divided into pasture, forest edge and forest interior habitat. Each habitat contained three permanent transects for a total of 126 transects sampled with an effort of 1008 man hours, during six times between June 2003 and April 2005. We recorded 2265 individuals of 23 amphibian species and 1111 individuals of 41 reptile species. We did not detected a direct and strong edge effect on the abundance and composition of amphibians, but seasonality and orientation were the most important effects to define edge and interior habitat patterns. North-faced ecotones showed almost twise individuals than south-faced ecotones. Contrary to amphibians, a strong edge effect was detected in species abundance and composition of reptiles that changed among seasons. We suggest to maintain high connectivity to improve dispersal of edge species between forest patches. Restoration must consider edge orientation and natural history of species (e.g. seasonal movements) to manage edges, buffer species invasion from the matrix to the forest, and to ensure high habitat quality for forest interior species to reproduce and survive in degraded tropical landscapes.

10:20 Last Glacial Maximum Distributions of Neotropical rattlesnakes based on Ecological Niche Modeling and Phylogeographic Information.
Adrian Quijada-Mascareñas; Juan Manuel Ortega; Wolfgang W¦¼ster; A. Townsend Peterson
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New approaches are integrating phylogeographic and ecological niche modeling to create robust projections of historical changes in species distributions. We analyzed historical changes in distributions of Neotropical rattlesnakes based on paleoclimate

models of the Last Glacial Maximum (LGM). For this purpose we: (1) tested niche conservatism in Neotropical rattlesnakes based on phylogeographic information and lineage-specific ecological niche models; and (2) applied two paleoclimate models of the LGM (21 Kya) to the niche model obtained to reconstruct potential geography of the species at LGM. Our results suggest that niche characteristics have been conserved in this group through all of the Pleistocene, and back probably still further. Although LGM projections from the two paleoclimate models showed slight differences, they coincide in reconstructing a larger distribution corresponding to drier past climates, including continuous dry potential distribution corridors connecting populations north and south of the Amazon Basin. This example highlights the power of combining phylogeography and ecological niche modeling in biogeography.

10:40 Space usage, movement patterns, and habitat selection of fer-de-lance (Bothrops asper) in Costa Rica

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Although the fer-de-lance (Bothrops asper) is a ubiquitous and somewhat notorious member of many Central American tropical ecosystems, very little data exist regarding its natural history. Here I report on the movement ecology and habitat use of a population of B. asper in Caribbean lowland rainforest of Costa Rica. 15 female and 6 male adult animals were tracked from December 2004 - December 2007 at La Selva Biological Station using radiotelemetry, with 34-595 fixes per individual. Snakes were located daily when possible (alternating day- and night-time observations), with a minimum of 4 locations per week. Tracking data from animals with a minimum of 100 fixes were used with ArcView GIS software to calculate annual home ranges (95% kernel, minimum convex polygon), movement patterns (net displacement, probability of movement), and landscape-level habitat usage versus availability. Observational data were used to characterize daily activity cycle and quantify microhabitat selection during various activities (e.g., resting, ambushing). Home range size varied individually but not yearly by both estimation methods, and preliminary estimates suggest that for this species, 95% kernels (mean size = 3.28 ñ 0.6 Ha) may be more biologically meaningful estimates than MCP (mean size = 4.98 ñ 0.9 Ha). Snakes were located most frequently in primary and some secondary forests, but many were strongly associated with small, forested swamp areas. Animals did not move at all between 34.3% of successive relocations, and 65.4% of movements were less than 10m, most likely representing brief forays between ambush sites and daytime refugia. This pattern was punctuated by occasional (10.4%) longer-distance movements of 50m or more, to a maximum single-night distance of over 600m. B. asper was confirmed as a highly nocturnal ambush hunter; daily cycles typically consisted of little to no diurnal activity, with evening hours spent coiled in stationary ambush. This information has provided valuable baseline information for subsequent study, and may allow identification of proximate factors related to the species*f*?T apparent decline at the study site

11-00 Coffee Break

11:20 Frog reproduction dynamics in a savanna river

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There is a widespread acceptance and concern that a global warmming is affecting reproduction dynamics of frogs in savanna rivers. So we set a experiment to evaluate such hypothesis. Our results suggests that global warmming is probably affect reproduction of frogs.

Pollination and plant reproduction. Part II

Room 6: Sala 2 (Second Floor)
Building: Centro Cultural Universitario
Thursday July 19

14:00 Does within-crown pollinator dispersal and self-fertilization promote stability of the mutualism between the Sonoran Rock fig and its fig wasp?
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The highly-coevolved interaction between figs (Ficus) and their fig wasp pollinators (family Agaonidae) is a textbook example of the obligate mutualism. Nonetheless, factors governing the persistence of the mutualism when host populations are small, as in stressful environments or at the limits of a species*ƒ*?T range, are poorly understood. In the wet or moist tropics reproduction is typically highly synchronized within the crowns of individual fig trees and highly asynchronous at the population level. Simulation studies indicate that under these phenological conditions, the long-term viability of a pollinator requires a host population of hundreds of fig trees. In contrast, in fig species occurring in more stressful desert environments populations are typically much smaller and spatially isolated. Working with the Sonoran Desert rock fig, F. petiolaris, we quantify geographical variation in within-crown reproductive asynchrony and at two sites test the hypothesis that this asynchrony facilitates mutualism persistence by permitting pollinators to cycle on their natal tree. At all sites examined within-crown asynchrony is substantial and often sufficient to produce wasp releasing (male-phase) and wasp receptive (female-phase) fig syconia on the same tree. If the cycling of pollinators on their natal tree is important to wasp persistence then a substantial fraction of fig syconia should contain selfed seed. Genetic marker analysis indicates, however, that the mating system of F. petiolaris is highly outcrossing and that individual crops of figs are sired by multiple pollen donors. In sum, the evolution of intra-crown asynchrony does not appear to be an adaptation for selfing as a mechanism for reproductive assurance in small populations. Nor does it appear to benefit mutualism stability by permitting pollinators to disperse within crowns. More likely, it increases the reproductive fitness of individual trees by increasing the probability of exchange of pollinators with other members of the population.

14:20 Diversification and coexistence of non-pollinating fig wasps on Ficus petiolaris, the Sonoran Desert rock fig
Day Kevin R.; Nason John D.; Bernhard Kristen K.; Stireman III John O.
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The well-characterized fig-pollinator wasp mutualism is host to a complex assemblage of non-pollinating (parasitizing) fig wasps whose biology and diversification is relatively poorly known.
Our research focuses on evolutionary mechanisms, such as host-shifting and co-

radiation, that have influenced the diversification of non-pollinating fig wasps. We are also interested in identifying the ecological mechanisms that facilitate their coexistence. The non-pollinating wasps, within the genus Idarnes (Sycophaginae), of Ficus petiolaris (subgenus Urostigma) were previously thought to be composed of two species based on differences in ovipositor valve length. mtDNA sequence variation and subsequent morphological characterization has shown that there are actually four distinct species: two with long ovipositors and two with short ovipositors. The coexistence of Idarnes within F. petiolaris has introduced several questions. First, in an evolutionary context, how have the four species come to co-occur on F. petiolaris? Several hypotheses have been proposed to explain the diversification of non-pollinating fig wasps. A recent study shows two independent radiations of non-pollinator colonization in Afrotropical figs. Our phylogeny of Idarnes on F. petiolaris, in contrast, shows a more complex history where host-shifting may be responsible for diversification. One species of Idarnes oviposits on F. pertusa in sympatric sites, further supporting the host-shifting hypothesis. Second, what are the ecological mechanisms that enable morphologically similar species of non-pollinators to co-occur? The assumption is that differences in ovipositor length circumvent competition for oviposition sites. Our pilot data contradict this assumption, indicating there is no difference in the size or developmental stage of F. petiolaris syconia that the long- and short-ovipositor Idarnes attack. There is evidence, however, of differences in longevity and dispersal ability that may contribute to their coexistence.

14:40 â?oREPRODUCTIVE INVESTMENT COSTS AND POLLINATION INFLUENCE FLORAL LONGEVITY AND SCENT CHEMISTRY IN Myrmecophila christinae (Orchidaceae)â??
Parra-Tabla Victor; Abdala-Roberts Luis; Navarro Alberto Jorge; Salinas Peba Luis
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Pollination and/or pollen removal from stamens have shown to reduce floral longevity, however, not much attention has been paid to the effect of reproductive investment on floral longevity. Likewise, pollination can also influence floral scent chemistry, and this is especially true for deceit-pollinated orchids. Thus, we chose Myrmecophila christinae, a deceit-pollinated orchid found in the Yucatan Peninsula, to address the following: (a) do floral longevity and scent chemistry change after pollen addition and/or removal in M. christinae? and (b) does experimental removal of flower buds increase flower longevity, and do flower bud removal effects interact with pollen manipulation effects? To study the effects of flower bud removal on floral longevity (days open), 48 plants were selected, of which half had 50% of their flower buds removed per inflorescence, while the other half did not. One month after bud removal, one of four pollen manipulation treatments were applied to a given flower on each plant (n = 48 plants, 170 flowers): controls (C), pollination but no pollinia removal (female success), pollination and pollinia removal (female+male success), and pollinia removal (male success). Likewise, to study the effects of pollen manipulation on floral scent chemistry, the same pollen manipulation treatments were conducted but on a different set of plants (n = 15 plants, 60 flowers), and flowers were collected at two time intervals (2 and 6 hours after treatment application) for chemical analyses. Flower bud removal significantly increased floral longevity (relative to controls), while pollen manipulation significantly decreased it; a significant interaction was found between factors. In addition, floral scent chemistry

changed in response to pollen manipulation relative to controls. In conclusion, pollen manipulation effects on floral longevity occurred both at short (hours: scent chemistry) and long (days: senescence) time intervals, and pollen manipulation effects on floral longevity depend on plant resource status.

15:00 Coffee Break

15:20 REPRODUTIVE ASPECTS OF THE ORCHID Masdevallia ignea IN CONDITIONS OF CULTURE IN THE BOTANICAL GARDEN JOSE CELESTINO MUTIS.
Chavarro Nathalia; Bonilla Maria Argenis; Cure Jose Ricardo; Pacheco Ricardo
Universidad Militar Nueva Granada; Universidad Nacional de Colombia; Universidad Militar Nueva Granada; Jardin Botanico Jose Celestino Mutis
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Masdevallia ignea is a semiterrestrial threatened orchid inhabitant of the high forests in the Colombian Eastern mountain range. This work was developed on plants of the collection of the Botanical Garden Jose Celestino Mutis. In order to determine some aspects of its reproductive biology in conditions of culture it was analyzed: its floral Biology, its reproductive phenology and its reproductive system. It was possible to establish that this specie in conditions of culture displays inflorescences with sepals of showy colors; the reproductive parts are internal and small; the flower is not adapted for self pollination, present homogamy during a period of five days and it does not display floral rewards. This species presents two annual period of blooming where each basal shoot can display several flowers simultaneously. This orchid is a complety self-compatible species that requires of a vector for the deposition of his pollinia on its stigma surface and it does not produce fruits asexually.

15:40 Reproductive ecology of neotropical forests
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Studies of small tropical forest plots have shown that dioecious species often form a large component of the species diversity in these systems, composing 16-25% of species at any one site. The apparent success of this sexual system in tropical forests compared to global estimates of the number of dioecious species (about 6% of all known species) is intriguing, given the reproductive handicap that taxa with half the number of seed-producing individuals face. Other studies have demonstrated the evolutionary success of dioecious taxa, compared to sister non-dioecious taxa. Here I present data on the ecological success of dioecious taxa within several large neotropical forest plots. At all sites, dioecious species constituted >20% of species as well as >20% of all individuals. Mortality rates were equivalent between dioecious and non-dioecious sister taxa. Higher recruitment or fitness of dioecious species may explain the success of these trees even in highly disturbed forests.

Litterfal and soil ecology

Room 7: Miguel Hidalgo (Second Floor)
Building: Colegio Primitivo de San Nicolás de Hidalgo
Thursday July 19

14:00 The cumulative and spatial components of land use determine the soil biota and fertility in productive plots of Los Tuxtlas

Negrete-Yankelevich Simoneta; Barois Isabelle; Bennack Dan E.; Bueno-Villegas Julian; Fragoso Carlos; García José A.; Gómez José A.; Morón Miguel A; Rojas Patricia; Santos Martín; Sormani Carlo; Fuentes-Pangtay Tajín; ¦?Ivarez-Sánchez Javier; Cram Silk

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Montecillo, Estado de M,xico; Programa de Fitopatolog¡a. CP-Campus Montecillo.
Montecillo, Estado de M,xico; Centro de Ciencias Gen¢micas, UNAM, Cuernavaca, Morelos; Facultad de Ciencias Agr¡colas, Universidad Veracruzana Xalapa Veracruz; Hongos y Derivados, S.A. Naucalpan de Ju rez Estado de M,xico
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In this study we consider the cumulative effects of land use and the influence of the spatial arrangement within productive plots on the belowground fertility and biodiversity. Three communities within the buffer zone of the Los Tuxtlas biosphere reserve were studied. We analysed the data produced by the Below-ground biodiversity and conservation project in Mexico (BGBD) and found that the cumulative effect of land use explained differences in below-ground biodiversity such as the richness of phytopathogenic fungi in pastures ($r^2=0.6$, $P<0.05$). Multiple factors related to the spatial arrangement of productive plots modify the effect of land use on the belowground system. For example, the proportion of perennial to annual plants was correlated with nematode richness ($r=0.4$, $P=0.01$) and the distance to the forest with the concentration of N- NO3 ($r=0.3$, $P=0.01$).
A historical land use intensity index (HLUI) was constructed based on the index proposed by van Noordwijk et al. (2002). The new measure differs from previous approaches in (1) that land-use intensity becomes a characteristic that individual plots accumulate through their history of usage and land use cycles with constant characteristics are not assumed; and (2) it considers differences in the initial susceptibility of the soil to impact (such as proximity to the forest and slope). This land use intensity measure may be calculated for any productive plot, independently of local specificities such as the identity of the crop or the land use system. The HLUI was parameterised, as far as possible, with primary data from the BGBD project. When the parameters were not available we resorted to figures in the literature that were obtained within the Los Tuxtlas region or in similar environments elsewhere in Mexico.

14:20 Litter fall accumulation and its relation with biotic and physical damage on plants in tropical rain forest edges

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Edge creation modifies the quantity and quality of litter in the understory with major implications on the seedling community. We studied the effect of litter fall accumulation on the seedling community and its relation with biotic damage (herbivores and pathogens) in tropical rain forest edges at Chajul, Chiapas, Mexico. We manipulate litter to determine the effect of litter amount on plant species diversity. Litter accumulation and litter quality (N and P) was assessed at forest edges and interiors. After 11 y of edge creation litter amount was similar at forest edges and interiors however, physical damage by litterfall was greater at forest edges (31.2%) explaining 40 % of the reduction on seedling density. Species richness was positively influenced by litter removal in forest interiors. We found significantly greater P concentration in litter at forest edges that may imply modifications on nutrient availability. Biotic damage by herbivores and foliar pathogens were positively influenced by the variation of litter amount. Hence, litter quality and amount in tropical rain forests influence the density and richness of seedling and biotic damage. By assessing the influence of edge formation on litter amount we can better understand regeneration at forest edges.

14:40 Increased aboveground litterfall causes losses of carbon belowground

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Litterfall represents a major flux of carbon from the vegetation to the soil, but the effects of increasing aboveground litter production, a possible consequence of elevated atmospheric CO2 concentrations, on belowground carbon dynamics are poorly understood. We used large-scale monthly litter removal and addition treatments in a lowland tropical forest to assess the consequences of increased litterfall on belowground CO2 production. Over the second to the fourth year of treatments, litter addition increased soil respiration more than litter removal decreased it; soil respiration was on average 21% lower in the litter removal (L-) and 35% higher in the litter addition (L+) treatment compared to the controls (CT). There was no change in microbial biomass in the L+ plots, thus we predicted a 10% increase in soil respiration in the L+ plots, based on the 21% decrease in the L- plots and an 11% reduction due to lower fine root biomass in the L+ plots. The 35% measured increase in soil respiration was therefore 25% higher than predicted. It is likely that this ƒ?~extraƒ?T CO2 was a result of priming effects, i.e. increased decomposition of older soil organic carbon by the addition of fresh organic matter. Our results suggest that increases in aboveground litter production as a result of global change could cause considerable losses of soil carbon to the atmosphere.

15:00 Coffee Break

15:20 The influence of rainfall and topography on the distribution of fruiting bodies of leaf litter fungi in a Central Amazonian forest: implications for inventory strategies

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Although fungi are important components of tropical systems, knowledge on fungal diversity over large spatial scales is scarce and fragmented, precluding conservation planning especially in Amazonia. The observation and collection of fruiting bodies have been used to determine macrofungal species occurrence in space and time, but the ephemeral nature of these reproductive structures difficult the detection of species. We tested if the distribution of fruiting bodies of litter fungi community was random in the landscape (over 25 km2) in a tropical forest in Central Amazonia, collecting fungi twice in thirty 0.25 x 250 m2 plots. We used linear regressions to evaluate the influence of rainfall and topography on morphospecies richness and composition. Altitude is strongly correlated with clay content in soil in study site (r = -0.977). Short-term rainfall was represented by the cumulative rainfall in the three days before each plot was surveyed, and plots were classified in two groups based on cumulative rainfall. Morphospecies richness (MR) responses to topographic factors depended on rainfall. In dryer periods, rainfall ($P < 0.001$) and clay content ($P = 0.005$) predicted MR, but in wetter periods clay content did not ($P = 0.198$). Higher rainfall apparently decreased limiting moisture conditions in higher areas, allowing fruiting body production and species detection. Morphospecies composition was influenced by clay content (dry periods, $P < 0.001$; wet periods, $P = 0.051$) and not by rainfall ($P = 0.678$; $P = 0.223$). However, the influence on fungi was probably indirect as clay content was correlated with altitude, plant community and nitrogen availability. Our results suggest that the species of litter fungi are not randomly distributed in the landscape. Moreover, they indicate that the temporal and spatial variation in fruiting bodies occurrence need to be taken into account if one is interested in maximizing species detection.

15:40 Quality of rooting environments and patterns of root colonization by arbuscular mycorrhizal fungi in strangler figs in a Mexican palmetto woodland

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Arbuscular mycorrhizal colonization in strangler figs, spore richness and abundance of arbuscular mycorrhizal fungi were quantified in epiphytic and ground-rooted trees in a Sabal palmetto woodland that had marked heterogeneity in rooting environments for hemi-epiphytic plants. An inoculation experiment was performed to assess whether low spore density could limit mycorrhizal colonization. There was no significant difference in mycorrhizal colonization among Ficus species, but epiphytic plants in nutrient-rich rooting environments had less mycorrhizal colonization than ground-rooted plants in low-nutrient soils. However, richness and abundance of spores was low and, to some extent, this limited the mycorrhizal colonization of strangler figs. Nevertheless, our results suggest intra-individual adjusting levels of root colonization in strangler figs in accordance with mineral availability. Such responses could maximize the cost*ƒ*?"benefit balance of arbuscular mycorrhizal interactions throughout the development of strangler figs from

epiphytic young plants to ground-rooted trees

The Ecological Role of Ants in tropical ecosystems. Part II

Room 8: Enrique Shuls (Second Floor)
Building: Colegio Primitivo de San Nicolás de Hidalgo
Thursday July 19

14:00 Spatial and seasonal variation in the foraging ecology of the forest-dwelling ant Odontomachus chelifer (Formicidae, Ponerinae)

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The natural history and foraging behavior of the ant Odontomachus chelifer was studied in two continuous Atlantic forest formations in SE Brazil. We examined how colony demography, diet, and activity rhythm vary spatially and seasonally in two study sites at the Parque Estadual da Ilha do Cardoso ƒ?" a sandy coastal forest and a lowland forest. Twenty ground-nesting colonies of O. chelifer were marked along trails in each area. Four colonies in each site were monitored in detail during one year to gather data on daily activity and diet. Immature and alates were more abundant during the wet season (October-March). The ants were active mostly at night, and the activity pattern seems closely linked with temperature and humidity. In general foraging activity decreases during the dry season when the risk of desiccation is probably higher, and prey availability lower. Colonies fed on a wide array of invertebrates, with solitary workers hunting for live prey and scavenging for dead animal matter (N = 92 items). Food items varied greatly in size (range 0,2-2cm), and were bigger in wet than in the dry season, and in the lowland compared to the sandy forest. Foraging is more intense in the warm/wet that in cold/dry season. More foragers leave the nest (up to fifty in period of bigger activity) and the percentage of successful foragers is higher (up to 40%) in the wet compared to the dry months. In conclusion, Odontomachus chelifer hunts opportunistically for a variety of food items, foraging more intensively in the wet period when brood is more abundant and abiotic conditions are more favorable. Quantitative data on food availability at different sites and seasons are needed to relate more precisely ecological factors and foraging strategies in this species.

14:20 The effect of habitat type and temperature on the foraging activity of two species of army ants (Eciton burchellii and Labidus coecus) in Neotropical montane forest

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Understanding how organisms use fragmented landscapes is central to conservation biology. Some forest-inhabiting organisms, such as predators with large home ranges, may be restricted in their movement across a habitat due to fragmentation. Army ants

(Ecitoninae) are top predators of the forest floor and are considered keystone species in tropical ecosystems. While hunting, army ants move in coordinated group raid parties. Some species, such as Labidus coecus, forage mainly underground. Others, including Eciton burchellii, forage aboveground. Neotropical montane forests are particularly subject to fragmentation due to favorable climatic conditions for agricultural use. As elevation increases, ambient air temperature generally declines. For this study, we asked how above and below ground army ant colonies make use of forested areas, and the open areas between them. We hypothesized that local abiotic factors related to forest clearing would affect these species differently due to their opposing foraging strategies. We measured above and below ground army ant raid activity in eight matched pairs of forested and open areas, across an elevation range of 1090-1540 masl. As expected, temperatures differed among habitat types (open vs. forested) and across elevations, with higher temperatures in open habitats and at lower elevations. For Eciton burchellii, raid rate was affected by habitat type, with ants seen less often in open areas than forested areas. However, the habitat effect disappeared at higher elevations. For Labidus coecus, raid rates did not differ among elevations, and there was no difference in raid rates among forested and open habitats. Labidus coecusƒ?T underground foraging behavior is apparently less constrained by ambient conditions. We discuss the implications of our findings for the effects of habitat alteration and climate change on the ecology of top predators in montane forest habitats.

14:40 Behavioral ecology at the insect-plant interface: oviposition by Eunica bechina butterflies on an ant-visited plant

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Larvae of Eunica bechina (Nymphalidae) feed on young leaves Caryocar brasiliense (Caryocaraceae), a shrub bearing extrafloral nectaries that is intensively visited by many nectar-gathering ant species in the Brazilian cerrado. Visiting ants exert strong selective pressure on larvae through predation and/or removal of the caterpillars on the host plant. This field study examines experimentally whether ant presence on Caryocar shrubs mediates oviposition decisions by Eunica females. Our aim was to determine the importance of an enemy-free space for the selection of a plant location for oviposition by the butterfly. Oviposition experiments on paired branches of Caryocar were designed to test egg-laying preference by Eunica in relation to the presence or absence of different types of mounted, pinned-insects. Field experiments demonstrated that presence of a specialist insect herbivore of Caryocar (Edessa rufomarginata, Pentatomidae), or of the non-aggressive visiting ant Cephalotes pusillus, had not effect on oviposition by Eunica females compared to insect-free control branches. On the other hand, we detected a significant reduction in oviposition frequency on branches with either of two aggressive ant species in the genus Camponotus compared to control, unoccupied branches. Avoidance of plant locations occupied by such aggressive ants persists even under high levels of competition for host plant. We suggest that Eunica butterflies use ant traits such as size and form as visual recognition cues to mediate oviposition decisions. By doing so the egg-laying butterfly reduces the probability of larval offspring encountering aggressive ants on the host plant. This capacity, in addition to an array of behavioral and morphological mechanisms, is apparently crucial to permit the butterfly to specialize on

such a risky, ant-defended host plant.

15:00 Coffee Break

Seed and Seedling Ecology

Room 9: Aristóteles (Second Floor)
Building: Colegio Primitivo de San Nicolás de Hidalgo
Thursday July 19

14:00 Distance and density effects near and far from conspecific adult trees: Nonâ?"random seed dispersal matters for seedling recruitment of the tropical rainforest tree Dipteryx oleifera.
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We present evidence addressing shortcoming in tropical rainforest literature dealing with the relative contribution of seed dispersal modes on seedling recruitment dynamics and we provide support for key predictions of the Janzen-Connell hypothesis. These results come from two unusually large seed threading and seedling demography datasets. Seed germination, seedling survival and seedling growth functions increased with respect to nearest D. olefiera adult tree. Low seedling survival near adults could be the result of larval insect seed predation (genus: Taeniaptera). Seed congregated at high density by bats below their roosting site could result in high seed and seedling mortality; thus leading to additional distance and density effects similar to those observed with respect to the adult trees. Bat and rodent seed dispersal are key steps to escape natural enemies below the adult trees and at the bat roosts. As a result of this dynamic seed dispersal there are spatial correlations between seed survival distribution, seedling establishment distribution and the distribution of three key palms used by bats as feeding roost sites (Welfia regia, Astrocarium alatum and Criosofila warsewitzii). Bat feeding roost formation occurred further from the adult tree where the natural enemies of bats (owls and boas) may be at low density; thus strengthening the Janzen-Connel pattern of seeds and seedlings in the forest floor.

14:20 Seedling dynamics and forest diversity: results from a lowland rainforest in Amazonian Ecuador
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Seedling dynamics may play an important role in determining forest structure and species composition in lowland tropical forests where gap regeneration is the major form of canopy turnover. Topographic variation and the diversity of the surrounding biotic neighborhood can act as strong filters during regeneration through species-specific habitat preferences or biotic interactions. These processes may play a large role in determining the composition of the advance regeneration, which is waiting in the understory to compete for openings in the canopy. Since 2002 I have monitored seedling dynamics inside the 50-hectare Yasuni Forest Dynamics Plot in Ecuadorƒ?Ts Amazon to quantify seedling densities and rates of recruitment, growth and mortality. I examined five years of spatial and temporal variation in seedling dynamics to assess the relative

importance of habitat specialization and Janzen-Connell effects by determining whether species demonstrated significant associations with topographic habitats and whether seedling performance varied with the density or diversity of the local biotic neighborhood. Although Yasuni has an aseasonal climate with ample rainfall throughout the year, recruitment rates varied significantly from year to year while mortality rates remained more constant. Many species show significant positive or negative associations with particular habitats in their abundance, growth or survival. Additionally, many species also show performance differences as the composition of the surrounding neighborhood changes. These mechanisms are not mutually exclusive, but may both contribute to the maintenance of diversity in this forest.

14:40 Recognizing endophytic fungi carried in seeds of Laelia speciosa, others epiphytic orchids and its symbiotic relationship

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Mycorrhiza-orchid relationships have been studied more in terrestrial than in epiphytic orchids. The present work deals with the extent and significance of such relationships in Laelia speciosa, and others epiphytic Mexican orchids. The objective of this study was to describe the relationship between the epiphytic orchid, L. speciosa and its endophytic fungi. Our hypothesis was that L. speciosa should contain the endophytic fungi inside the seeds in capsules sampled in different populations and in seedlings growing in vitro. We predicted that seed germination and seedling development require the presence of endophytic fungi. Seeds and in vitro seedlings of L. speciosa were observed at different developmental stages. We designed a fungicide experiment in vitro to assess the symbiotic relationship, hypothesized that if fungicides inhibited growth of symbiotic fungi they should reduce development and survival of L. speciosa seedlings. Others seedlings of epiphytic orchids grown in vitro such as Laelia autumnalis, Cattleya aurantiaca, Epidendrum parkinsonianum, Euchile citrina and Encyclia adenocaula, were also observed to confirm the presence of fungi.
Fungal colonization in L. speciosa was dependent on seed maturity. Fungi were present in all the seeds observed from different populations. Increasing fungicide concentration (ƒ%¾ 0.25 g l-1) decreased fungal colonization and plant development significantly. L. speciosa apparently has a specific symbiotic relationship with endophytic fungi. All the others epiphytic orchids growing in vitro also had fungal colonization. This is the first report of the existence of endophytic fungi within orchid seeds. We consider that this finding has important ecological advantages for seed germination and establishment of seedlings of these epiphytic orchids.

15:00 Coffee Break

15:20 Seedling recruitment of Ipomoea pes-caprae and Canavalia rosea at Laguna de la Mancha, Veracruz, Mexico

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Ipomoea pes-caprae (Convolvulaceae) is a pantropical perennial vine that grows on coastal beaches and dunes in the tropics and subtropics. Canavalia rosea (Leguminosae) is a legume that is common on the coastal beaches of Mexico. It occupies the same habitat as I. pes-caprae but is restricted to frost-free areas. The purpose of this study was to analyze seedling recruitment in the two species. We used seed-sowing experiments to determine how germination, seedling survivorship and juvenile growth are related to the natural occurrence of adult plants and to different factors in the habitat of the two species. Three questions were asked: under what conditions does successful seedling recruitment occur, to what extent do these conditions occur in natural populations, and is the relationship between germination, seedling survivorship and occurrence of adult plants similar in different areas of the beach. For each species there were two seed treatments: scarification and no scarification and controls. Half the quadrats were in areas with plant cover and half were in areas with little or no plant cover. The study demonstrated that scarification of seed is necessary for germination in both species. ƒ?~Windows of opportunityƒ?T for seedling survival are scarce for both species. Seeds of these species mature mostly in late summer at La Mancha, and are likely scarified by ƒ?~nortesƒ?T during the winter, and then probably germinate in spring. Perhaps a summer with more rain than usual following a winter with severe ƒ?~nortesƒ?T would provide an opportunity for germination and survival.

15:40 Seed limitation and niche partitioning among neotropical seedlings

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The relative importance of dispersal and niche processes in structuring plant communities at the seedling stage has rarely been evaluated simultaneously. To address this issue, we used a set up combining seed traps, seedling plots, and fine quantification of environmental variables. For 15 taxa (10 trees and 5 lianas) we determined the proportion of variance in seedling abundance patterns explained by either seed arrival or environmental factors, and we assessed the effect of environment on seedling survival. Seed arrival explained a large portion of the variance in six taxa. In contrast, niche partitioning only provided limited explanatory support power for three taxa. The six other taxa showed random patterns with respect to both seed input and habitat conditions. Environmental effects on seedling abundance appeared to be weakly related to those on seedling survival. When seedling density was significantly associated with a given environmental factor, survival was not associated with that factor. Such patterns illustrate the complexity of the interactions between plants and environment through different developmental stages. Our study demonstrates that taxa display different responses to seed arrival and environmental filtering. Variation among species in their regeneration patterns is likely to contribute to species coexistence in tropical forests.

Evolution and Genetic Diversity of plants

Room 10: Manuel Altamirano (Second Floor)
Building: Colegio Primitivo de San Nicolás de Hidalgo
Tuesday July 17

14:00 Hybridization and genetic diversity of East Pacific black mangroves, Avicennia germinans (L.) L. and A. bicolor Standl. (Avicenniaceae)
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One of the hypotheses that can explain the high genetic diversity and deep divergence found in Pacific Central American populations of the widespread black mangrove, Avicennia germinans (L.) L., is hybridization of this species with the more restricted, partially sympatric A. bicolor Standl. A. germinans and A. bicolor can form mixed stands where they occur in sympatry. However, these species are morphologically and ecologically differentiated. We tested the hypothesis of hybridization between these two species using phylogenetic analysis of the internal transcribed spacer region (ITS) of the nuclear ribosomal DNA, the trnD-trnT intergenic spacer of chloroplast DNA, and population genetic analysis of nuclear microsatellites. Discordance between the ITS dataset and chloroplast and microsatellite data suggest ancient introgression of this nuclear ribosomal region between the two species. This hybridization event likely happened along the coastlines of Northern Central America before the Holocene. Microsatellite data revealed contemporary isolation between the two species. The introgressant A. germinans lineage recolonized towards Mexico to the north and southward to the Nicoya Gulf, Costa Rica, where it came into secondary contact with a southern Central American lineage of A. germinans. Polymorphic ITS sequences from Costa Rica and Panama are consistent with a zone of admixture between these two lineages. Our results show that inter-specific hybridization as well as intra-specific population differentiation and admixture are responsible for the relatively high genetic diversity in Pacific Central American A. germinans populations.

14:20 Genetic variation in eight populations of Acacia brevispica (Fabaceae: Mimosoideae) in East Africa tropical savanna, levels of fine spatial genetic structure and family structure.
Otero Arnaiz Adriana; Marshal Michelle; Swearingen Andrew; Ruiz Guajardo Juan Carlos; Stone Graham; Schnabel Andrew
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Knowledge of the genetic patterns and variation inside and among populations of keystone species is essential to design conservation and management strategies for the species and maintenance of their communities. Here we describe the genetic variation levels and structure of eight Acacia brevispica populations, a keystone tree of the tropical sabana in Laikipia, Kenya. Variation in a total of 179 alleles in eleven microsatellite loci

for a total of 365 individuals was HE = 0.813. Most of the variation was observed among individuals. Populations of 30 to 50 individuals each showed significant differentiation (FST = 0.04). This differentiation is explained mainly for the distance between them. Acacia brevispica grows as small trees or clustered shrubs. These clusters may be the result of the proliferation of ramets of the same genet following herbivory by large mammals such as elephants. We have analyzed the genetic diversity of Acacia brevispica at different spatial scales in Laikipia, Kenya. We used eighth microsatellite loci, representing 87 alleles, to investigate clonal growth and limited gene flow through pollen or seeds as causes of spatial genetic structure in two plots of 80 x 100 m and 200 x 150 m. We identified the clones from the expected likelihood of the 5-loci genotypes and excluded ramet pairs before characterizing the spatial genetic structure of mapped individuals. Additionally familiar structure, the frequency of multiple paternity inside flowers and inflorescences was estimated with six loci

14:40 The role of refugia in the intraspecific differentiation of Aucoumea klaineana (Burseraceae)

Born Celine; Alvarez Nadir; Ossari Simon; Muloko Nicole; McKey Doyle; Wickings E. Jean; Hossaert-McKey Martine; Chevallier Marie-Hel¦•ne
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We will give evidence for the role of forest refugia in structuring biodiversity in central African rainforests, based on intraspecific differentiation of Aucoumea klaineana. In central Africa, paleoenvironmental studies have demonstrated that rainforests were very fragmented during two cold and dry periods in the last 25000 years, the Last Glacial Maximum (LGM) at the end of the Pleistocene and a Mid*ƒ*?"Holocene period (between 3500 and 1500 years BP). Climate-sensitive species should have persisted only in refugia, with only some of them expanding since into areas between refugia, explaining contemporary gradients in species diversity. However, it is often difficult to separate the effects of history and of present-day ecological conditions on patterns of diversity at the interspecific level. Because fragmentation and expansion from refugia should also affect intraspecific genetic diversity, studies at this level could provide independent and less ambiguous tests of the existence of refugia and their role in explaining diversity gradients. Aucoumea klaineana, a long-lived climate-sensitive pioneer rainforest tree, is a good model for analyzing how refugia could affect genetic structure. We collected leaves from 660 trees throughout a large part of the geographic range of the species and analyzed them at 10 nuclear microsatellite loci. Using Bayesian approaches, we demonstrated the presence in the sampled area of four differentiated genetic units, whose distribution matched that of putative forest refugia postulated from likely paleoclimatic conditions and from patterns of species richness and endemism. These were all in elevated regions. Moreover, higher allelic richness was found not only in these regions, but also in areas of admixture between lineages associated with different putative refugia. Hence, our results confirm predictions based on the refugia hypothesis and underline the role of elevated areas of the Lower Guinea Forest Domain in the conservation*ƒ*?"in the past, present and future*ƒ*?"of rainforest biodiversity.

15:00 Coffee Break

15:20 DNA bank of Brazilian endemic and endangered fauna.
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Although the loss of biodiversity resulting from extinctions is receiving increasing attention, the accompanying decrease in access to genetic resources has not been widely discussed. In the future, according to Ryder et al. (2000), DNA sequencing will be fully automated, and our descendants will be able rapidly to derive the sequence of any organism whose DNA has been appropriately collected and stockpiled. If sufficient genomes are available, they will be able not only to reconstruct what the organism was like, but also what its evolutionary relationships were, how specific genes arose to encode proteins that perform specialized functions, and how regulatory programming evolved. Tropical ecosystems are rapidly disappering and our knowledge about the genetic content of many species is very poor. The objetive of our study was to create a DNA Bank of the Brazilian fauna at the Universidade Federal Fluminense, in Rio de Janeiro city, to preserve samples from endemic and endangered species. The DNA was extracted from blood samples and feathers, from different animal species, by phenol-chlorophorm method (Sambrook et al. 1989) and preserved at -70oC. The DNA bank homepage can be accessed by foreign biologists, and samples can be requested under specific conditions, although creating a concrete mechanism to disseminate information and to promote coalition of scientists, encouraging novel partnerships between tropical and temperate zone institutions and scientists.

15:40 Cryptic genetic bottlenecks and restoration of Araucaria nemorosa, a critically endangered New Caledonian endemic conifer
Kettle Christopher James; Jaffre Tanguy; Hollingsworth Pete; Ennos Richard A
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The long-term success of any forest restoration programme depends on the genetic quality of the material used. Genetically depauperate or inbred planting stock may lack vigour or sufficient variation to adapt to future environmental change. Ultimately this may compromise the success of a restoration programme. The aim of this study was to monitor the genetic quality of nursery propagated seedlings used for the population restoration of critically endangered conifer species. Microsatellite markers were used to investigate the potential for cryptic genetic bottlenecks in seed collection for forest restoration of a critically endangered New Caledonian endemic conifer Araucaria nemorosa. The genetic diversity in nursery reared A. nemorosa seedlings was compared to that of wild seedlings growing in parent populations from which the nurseries collected seed. Nursery reared seedlings exhibited both a significant loss of genetic diversity and elevated inbreeding. Allelic richness (Ae) declined from 8.83 to 2.81 ($p < 0.05$) and inbreeding coefficient (Fis) increased from 0.173 to 0.282 ($p<0.05$) in nursery stock compared to wild seedlings. We discuss the implications of different collection strategies

for establishing genetically robust planting stock for restoration of New Caledonian Araucaria forest.

POSTERS

Restoration of tropical ecology

MONDAY JULY 16

Nurse plant vs Nurse object: The effects of woody plants and rocky cavities on the recruitment of the Pilosocereus leucocephalus columnar cactus
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Most studies on cactus recruitment have focused on the role of woody plants as seedling facilitators. Although object-facilitated establishment has been suggested for cacti, the mechanisms which maintain the association with objects remain poorly understood. The aims of this study were to identify which mechanisms facilitate association with objects, at which stages of recruitment these occur and to compare these mechanisms with those involved in plant-plant facilitation. We explored these mechanisms in the Pilosocereus leucocephalus columnar cactus, an ideal study object, as it grows in association with both microtopographic irregularities and woody plants.
We conducted three field split-split plot experiments to compare the effects of two microhabitats (rocky cavities and plant canopy shade) on seed removal, germination, seedling survivorship and growth, using flat, open spaces as a control. For each microhabitat, we also explored the effect of herbivores and substrate limitation, and characterized aboveground microclimate and some soil properties. The permanence of superficial seeds was greater inside rocky cavities than beneath woody plant canopies or on flat, open areas. Germination was similar in cavities and beneath plant canopies, but significantly higher than on flat, open areas. Seedling survivorship was greater beneath plant canopies than inside cavities or on flat, open spaces.
Conclusions: Mechanisms of plant facilitation are different from those of object facilitation. There are seed-seedling conflicts involved in the recruitment of P. leucocephalus: nurse plants favour mainly seedling survivorship by providing a suitable microenvironment, while nurse objects mainly favour seed permanence, by protecting these from predators. In spite of differential selection, the positive effects of each of these microhabitats offset the negative ones, thus leading to the successful association of this cactus with both microhabitats.

Growth Projection of Commercial Species Regenerating in Strip Clear-Cuts in the Peruvian Amazon
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Strip clear-cutting (or Palcazu Forest Management System) is a natural forest management system that has been proposed as a sustainable alternative for timber extraction in the tropics. In this system, tropical forests are managed for native gap-dependent timber species by clear-

cutting long, narrow strips every 30 to 40 years. To assess the economic viability of this system, we determined whether the most common commercial species in two 15-year-old strips (30 x 150 m) clear-cut in the Peruvian Amazon would reach commercial size in the next 25 years, in time for a second cutting. The commercial species projected were Cedrelinga catenaeformis (Fabaceae), Eschweilera bracteosa (Lecythidaceae), Guarea cinnamomea (Meliaceae), and Pouteria guianensis (Sapotaceae). Using bootstrapping (Lieberman and Lieberman 1989), we projected the growth of individual trees of each species found in the strips. Diameter increments over a 2-year period were obtained from 700 individual trees of the selected species ranging from 3 to 30 cm dbh growing in secondary sites. These trees had similar crown illumination conditions as the trees growing in the strips. A cutting cycle of 40 years may not be sufficient for these species to reach commercial size. This indicates that the strip clear-cutting system may not be financially profitable in a potential second cutting.

Recovery of mature forest tree species following slash-and-burn agriculture in the Yucatan Peninsula

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Among the principal causes of the high rate of tropical deforestation is slash-and-burn agriculture, which generates a continuous cycle of disturbance followed by forest recovery. Most research on secondary forest succession has focused on the establishment of early successional species, but less is known about the time scales at which mature forest species recover. Although secondary forests can be structurally similar to mature forests, they could be arrested in a stable stage composed mostly of early successional species. We studied sustainability of slash-and-burn agriculture and vegetation succession to: (1) document community composition and forest structure at different successional stages following agricultural abandonment and, (2) ask whether mature forest species are re-establishing in these sites. In the Yucatan Peninsula, where slash-and-burn agriculture is widely practiced, we sampled 40 transects (100 x 2 m) in four forest age categories (10 per category) from recently abandoned plots (8-15 yr), intermediate succession sites (16-29 and 30-50 yr), and the oldest available reference forest (>50 yr). We recorded and identified all stems >1 cm DBH, as well as recruiting vegetation (<1 cm DBH, <1 m high) in four 1 x 2 m plots per transect. Our results show that stem and species density are higher and basal area is lower in the oldest sites (>50 yr), these values do not vary among the other site ages. Similarly, many of the same species are present in all sites <50-yr old. The oldest forests are characterized by fewer species, and several late successional species rarely observed in younger forests. In general, recruitment was low even for common species, such as Bursera simaruba. Overall, these forests show a high degree of resilience, but some of the mature forest species, important to local fauna, are not regenerating and may need to be introduced.

Survival and Growth of Stakes of Three Native Species for Restoration in Degraded Sites at Chiapas, Mexico

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A number of biotic and abiotic factors may act like barriers for tropical forest recovery in

abandoned pastures, many of which are caused or maintained by a lack of a tree canopy layer. An alternative for regenerating forests under such conditions is to restitute the tree layer with species that can establish by vegetative means. A common agricultural practice in the Mesoamerican tropics is to construct living fences, a traditional technology which might be used to restore tree cover for restoration purposes. In this study we evaluated survival and growth of stakes of the native tree species Bursera simaruba, Gliricidia sepium and Spondias mombin, commonly used for building living fences in Chiapas, Mexico. After the first year, individuals of G. sepium showed the highest survival (53.3%), followed by B. simaruba (37.8%) and S. mombin (22.2 %). The growth rate of G. sepium was three times faster (F=8.6; P=0-001), produced more and longer branches, and produced more leaves than the other two species. G. sepium is also the species most frequently used to build living fences by local people. We suggest that the use of stakes of G. sepium could be an unexpensive but effective restoration strategy to bring back a tree canopy in this region of Mexico

Plant diversity and your effect in the generation of ecosystem services.
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The importance of the plant diversity on the ecosystem functioning and the generation of ecosystem services has been strongly recognized, and is particularly relevant given the eminent loss of biodiversity and the transformation of natural ecosystems. The majority of experimental and theoretical work on this issue has provided only limited information on certain biodiversity attributes and very few ecosystem services. In this study we will evaluate the importance of different organization levels and attributes of the plant diversity on the generation of ecosystem services, defined following the Millennium Assessment framework. We present two quantitative assessments: 1) a meta-analysis of experimental work spanning 50 years to June 2004 seeking to describe the relationship between biodiversity and services, considering only the measurements carried out in terrestrial ecosystems and with manipulations to primary producers,; 2) an expert knowledge assessment, derived from a survey applied to researchers of different fields of ecology scientists to explore their perceptions on the influence and importance of plant diversity in the generation of ecosystem services at a regional scale. We found that different plant diversity attributes, and different levels of organization of such diversity, are relevant for the generation of ecosystem services that operate at different spatial scales. We found a positive relationship between diversity and all types of services (supporting, provisioning, regulating, and cultural). The new challenges brought with intensive management of ecosystems, emphasize the importance of the role played by different attributes of the plant diversity in the generation of ecosystems services that are crucial to human well-being.

Spring restoration in brazilian cerrado in the experimental farm of embrapa gado de corte, campo grande,ms, Brazil
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The Cerrado is a biodiversity

ƒ?ohotspot ", but the process of forest fragmentation is increasing due to agricultural and livestock expansion. This fact has as consequence soil erosion, silting of water courses, degradation of several springs and extinction of many species. The aim of this work is developing techniques for restoration of six springs in the experimental farm of Embrapa. This research began in December of 2004, with the construction of the nursery and seed harvest in forest fragments for the production of seedlings of native arboreal species of Cerrado riparian forests. The methodology involves cattle exclosure, planting of seedlings of native species distributed alternated (pioneer and non pioneer) in two distances and installation of perches. For selection of species the physiologic pattern was used, that classifies species according to successional category (pioneer and non pioneer), as well as for their functionality for landscape restoration. At this stage, seedlings were transplanted on two springs in the beginning of 2007. In each spring were used the species which had successful development in the nursery: Amburana cearensis (Fr.Allem.) A.C. Smith, Calophyllum brasiliense Cambess., Cedrela fissilis Vell., Croton urucurana Baill., Pseudobombax tomentosum (C.Martius & Zuccarini) Robyns, Genipa americana L., Hymenaea courbaril L., Inga vera Willd., Jacaranda cuspidifolia Mart., Myracrodruon urundeuva Allemao, Schefflera morototoni (Aubl.) Maguire, Steyerm. & Frodin, Tabebuia roseo-alba (Ridl.) Sandwith, Tapirira guianensis Aubl. After 30 days of planting the mortality rate in spring I and II was respectively 16.15% and 11.67%. The species with highest rate in spring I were: C.fissilis (24.70%), C.brasiliense 13.25% and I.vera (13.25%), and of Spring II were C.brasiliense (20.78%), M.urundeuva (19.48%) and T.guianensis (14.28%). The highest mortality rate in spring I was consequence of larger water stress than spring II. These results show that it is possible to restore springs with native species, using this technique.

Epiphytism in two restored cloud forests: Patterns and ecological implications

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Forest restoration can be achieved by different means, such as planting trees or allowing natural regeneration to occur. The relative effectiveness of different restoration strategies has rarely been evaluated for tropical forests. Here we report on an evaluation of the relative effectiveness these two strategies for the establishment of epiphytes, and the ecological implications for rainfall retention in the Colombian Andes of areas that were restored 40 years ago. We compared monodominant plantations of Andean alder (Alnus acuminata) with adjacent and same-age mixed forests that resulted from natural succession. Prior comparative studies between these two types of restored forests conducted in the region, indicated that plantations yielded forests with a lower species richness, and that the canopy of the plantations was thinner due to the smaller size of the crowns and the absence of undercanopy trees.

We counted the number of vascular epiphytes and estimated the percentage of cover of non-vascular epiphytes of all trees with DBH>5 cm in fifteen plots (4x25m) per forest type. We measured rainfall retention. We conducted these measurements during one dry and two rainy seasons. We found no differences in the number of vascular epiphytes. Nevertheless, the cover of non-vascular epiphytes was different on the branches and the trunks of both forest types. Canopies differed seasonally in their rainfall retention. In the rainy season the plantation retained 25% more rain than the forests, but in the dry season the pattern was inverted and alders retained 73% less than their counterparts. This apparent paradox is explained by two factors: the size of the bromeliads and the leaf phenology of the alders.

Fruiting trees as biodiversity promoters in tropical forests: a case study with Cecropia spp.
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The vast majority of tropical plants depend on frugivores for the dispersal of their seeds. Zoochorous trees produce rewards (fruits or parts thereof) that attract animals to disperse their own seeds. This opens the possibility that fruiting trees may operate as foci of attraction of frugivores that may carry seeds from other trees of the same or other species. We hypothesized that, if this the case, such foci of attraction would lead to an increased arrival of seeds and seedling/sapling banks underneath those trees. To test this hypothesis, we chose, as model study dioecious trees of Cecropia given that fruit-bearing (female) plants can be ideally compared with control, non-bearing fruit (male) plants. Ten haphazardly selected male and female trees were used to analyze the plant community present underneath them, using four 1m2 quadrats per tree. The study site was the Ilha de Cardoso State Park, Sao Paulo state, Brazil. All plants present in the quadrats were identified and counted to estimate total plant density, density of zoochorous species and species richness. We found that the data supported our hypothesis. As compared to male plants, plant density was about twice as high; total species richness was 70% higher and abundance of zoochorous species was 230% higher underneath female plants. These results suggest that fruiting trees can have an effect of attraction foci to frugivores that, in addition to mutualistically interacting with the fruiting plant, may have a positive effect on the dispersal and establishment of other plants of the same or other species. We believe this is the first documentation of such a multiple mutualism of tropical fruiting plants. The persistence of this effect and its consequences for understory plant dynamics and regeneration warrants further research. Support: CYTED, FUNDUNESP, UNESP, UNICAMP.

Trends in soil carbon with reforestation in the Neotropics
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Reforestation of degraded and abandoned agricultural lands has been proposed as a mechanism for increasing carbon (C) sequestration in plant biomass and in soils. While forest regrowth is typically associated with C accumulation aboveground, the effects belowground are varied. Studies report soil C gains, losses, or no net change. We compiled data from 189 plots from 34 studies in Neotropical secondary forests and plantations and tested for the effect of previous land use (agriculture, pasture or cleared only), present cover type (secondary forest versus plantation), and life zone on soil C stocks over time since reforestation. There were no significant differences in average soil C stocks between forests growing on former agricultural lands and those on pastures, or between forests ƒ%ï 20 and > 20 years old. Time since abandonment had a significant (p< 0.01) but very weak (r2= 0.05) effect on soil C stocks to

0.25 m, and this effect was only observable in moist and dry tropical forests, not wet forests. Dry forests showed the strongest relationship between age and soil C, although this life-zone had the fewest data points. Past land-use also had a significant effect on soil C, with forests on formerly cleared land showing the strongest relationship ($r^2 = 0.41$, $p = 0.06$) while those on former agricultural sites showed a weaker relationship. Sites re-growing on former pastures did not show any trend with time since abandonment. Soil C stocks changed very little, or not at all, with time since abandonment, and appeared to be considerably resilient to changes in land use and plant cover. The low predictive power of time suggests that there are other factors influencing rates and direction of soil C changes with secondary succession in the Neotropics.

Forest fragmentation and conservation genetic

MONDAY JULY 16

Assessment of man-animal conflicts with special reference to the livestock depredation by lion (Panthera leo persica) and leopard (Panthera pardus) in Gir Ecosystem, India.
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Conflicts between wildlife and human are escalating owing to increasing human population, loss of natural habitats for wildlife and gradual increase in wildlife population due to successful conservation efforts. The Gir forest ecosystem, western India is the only home for free ranging Asiatic Lion (P. leo persica), the lions are also share their resources with another greater cat, leopard (P. pardus) in the forest. Due to less availability of wild prey as well as water in the forest, both the predators are often visits the villages in vicinity for food and water which increase livestock depredation leading to conflicts with villagers. To assess the conflict, data regarding the livestock depredation were collected during the study period (August 1997 ƒ?" March 2000); moreover secondary data were also collected of last five years from the office of the forest department. Further the cattle holder villagers were interviewed using a questionnaire to know the perception of local people towards the wildlife in the area. Compensation rates of the depredated livestock were asked to each interviewee and were confirmed by obtaining the same from the forest authorities and these were compared with the current market value of the cattle. The analysis of the above data show that the livestock killed by leopard were more in the village area than the forest where as livestock killed by lion were found more in the sanctuary area which shows the infiltration of livestock in the sanctuary causes their predation by lion. The hostility of local people towards lion and leopard are mainly due to the lower rate of compensation and economic loss which is found the key cause of the conflict. The increasing rate of conflicts is alarming for the management when the top priority species for conservation like Asiatic lion is involved.

Phylogeography and conservation genetics of the Neotropical palm Mauritia flexuosa (Arecaceae)
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Mauritia flexuosa L. f. (Arecaceae) is a widely distributed Neotropical palm, found in permanently flooded soils in gallery forests and in pure stands known as morichales (Colombia and Venezuela), aguajales (Peru) and veredas (Brazil). Climatic fluctuations during the Tertiary and specially the last glaciation may have affected the current distribution of Mauritia and phylogeographic pattern. We are interested in study population genetic structure, gene flow and phylogeography of M. flexuosa, to better understand the biogeographical history and generate useful information for conservation strategies. In this work, we report the phylogeography of the species based on the sequencing of two chloroplast non-coding region,

the trnL intron and the intergenic region between psbA and trnH genes. As M. flexuosa distribution is constrained by water courses, we also tested the hypothesis that the major river basins represent phylogeographic breaks to the distribution of maternal lineages. Only two different haplotypes were found for trnL intron and five for psbA and trnH intergenic space, among 30 individuals. Although, trnL did not present variation among populations within each river basin, both sequences showed distinct clusters distributed on the two river basin analysed in the present work: Parana and Sao Francisco, supporting our hypothesis that river basins may represent phylogeographic break for M. flexuosa. Further analysis including populations of Araguaia/Tocantins and Amazonia Basin will be performed to better understand the biogeographical history of M. flexuosa

Effects of anthropogenic disturbances on the regeneration and population dynamics of Bursera glabrifolia in a tropical dry forest.

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Tropical dry forests are an important source of a number of forest products. The overexploitation of some of these products is one of the many threats faced by these ecosystems in Mexico. Bursera glabrifolia is a tree species commonly extracted from tropical dry forests in Mexico, and is used for folk wood-crafting. Tree extraction creates local disturbances (canopy gaps); thus, patch dynamics is driven to a large extent by human intervention. Therefore, management plans for this and other forest products should incorporate the knowledge of how the ƒ?~target speciesƒ?T responds, in relation to regeneration and population dynamics, to the different disturbance regimes and management techniques applied by the local communities. In this study we address the regeneration response of B. glabrifolia to canopy gaps of different sizes formed by selective tree extraction. We carried out germination and seedling establishment experiments in four different patch types: closed canopy patches, small gaps, medium-sized gaps and large gaps. Average seed germination was highest in small gaps (8.94% germination), followed by closed canopy patches (5.37%), medium-sized gaps (2.18%) and large gaps (0.92%). Seedling survival after one year of planting was highest in closed canopy patches (4.40% survival), followed by small gaps (1.37%), medium-sized gaps (1.15%) and large gaps (0.22%). We explored the demographic effect of these regeneration patterns by incorporating them in population projection matrices to model the potential numerical behavior of the population in the different forest patches. The resulting $\bar{\times}$ values suggest that B. glabrifolia populations would grow at a faster rate under the conditions prevailing in small gaps ($\bar{\times}$ =1.045), while the lowest $\bar{\times}$ would occur in large gaps (0.998). This results suggest that the demography of this species shows spatio-temporal variability, expressed mainly in relation to the regeneration behavior, associated with the patch dynamics occurring at the landscape level.

Extensive gene flow in Carapa guianensis populations among fragmented habitats in the Osa Peninsula, Costa Rica

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Pollen dispersal is an important component of gene flow between populations of tropical trees. Habitat fragmentation can disrupt pollen flow between trees by limiting pollinator movements

through open areas and ultimately decreasing the number of pollen donors and pollinator populations. Nevertheless, the effect of fragmentation on pollen dispersal in any particular population appears to be idiosyncratic and depends on several factors including: pollinator vector, population density of fragmented populations, degree of forest fragmentation, and time since habitat fragmentation. In this study pollen gene flow in a tropical tree (Carapa guianensis, Meliaceae) was studied in a fragmented tropical wet forest in the Osa Peninsula, Southeastern Costa Rica. An exhaustive census of adult individuals was performed in a 4 km2 area consisting of forest fragments and open pastures. 36 adult trees and seven seedling groups within this area were genotyped for 7 microsatellites. The analysis of pollen flow by paternity assignment and fractional paternity revealed few pollen movements between nearby individuals, the possibility of long distance pollen movement through open areas, and the existence of a greater male breeding population than the one included in the sample. These results may be explained by extensive pollen movement across fragmented landscapes, suggesting that the main pollinator agent of this species (small insects) maintains a large interbreeding population in spite of habitat discontinuity.

Rainforest Fragmentation and the Establishment of an Arboreal Palm (Oenocarpus bacaba Mart.) in Central Amazonia

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We present results of a study on the effects of forest fragmentation on the establishment of the arboreal palm Oenocarpus bacaba in an experimentally fragmented landscape in Central Amazonia. In a set of 21 1-ha permanent plots, tree recruitment and mortality of individuals ƒ%¾ 10 cm DBH were recorded in fragmented (edge habitats) and continuous (interior habitats) forests over a 22-year period. In addition, 12 0.7 x 14 m sub-plots were established within each 1-ha plot to count all seedlings and saplings 5-400 cm tall in 2005. The number of individuals recruited ha-1year-1 was, on average, over two times higher in the edge than in the interior. O. bacaba mortality, however, over the census interval was quite similar between habitats. As a result, the mean net difference between recruitment and mortality at the edge habitat was much greater than in the interior, which represented an increasing of 224% in the population size of individuals ƒ%¾ 10 cm DBH at the edges, whereas density of O. bacaba in the interior remained constant over the study period. The density of seedling and saplings was significantly lower in the edge in comparison to the interior of the forest. Edge plots presented a much higher proportion of plants in the > 100 cm height class than in the interior (10.6% vs. 2.4%, respectively), and the proportion of individuals trended to be higher in the smaller height size classes in the interior habitats. Overall, our results highlight the need to consider all tree size categories in order to effectively assess the effects of forest fragmentation on individual

plant populations. The elevated recruitment into ƒ%¾ 10 cm DBH class of post-fragmentation established O. bacaba individuals in the edges habitats initially suggests that this palm has been favoured by fragmentation as a result of edge-related abiotic changes.

Land-cover change and patterns of tree infection by the mistletoe Dendropemon caribaeus (Lorantahceae) in northern Puerto Rico.

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New and re-emerging diseases are becoming increasingly prevalent in many parts of the world, and it has been hypothesized that this is the result of major changes in land use. From the perspective of the infectious agent, this translates into an expansion of their geographical range. From the point of view of the host, this may result in changes in disease prevalence and/or infection of new hosts. The main goal of our work is to understand patterns of tree infection by the parasitic plant, Dendropemon caribeaus (Loranthaceae) in northern Puerto Rico. D. caribeaus is endemic to the Caribbean and in Puerto Rico has been reported from localities along the highly, transformed coastal areas of the island. Specifically we intend to answer two questions: (1) What is the contribution of native and introduced species to landscape patterns of infection prevalence? (2) How do landscape characteristics influence patterns of host preference? Using a Geographic Information System, we randomly located 50 sampling points along the road network running through our 345 km2 study region. Each sampling point consisted of a 100 x 2m transect running parallel to the roads along which we inventoried all trees. We measured all individuals parasitized by D. caribaeus and counted the number of mistletoes per host. Sampling points were characterized by the composition of land use types. Our preliminary results show that D. caribaeus is using six hosts, including three native and five introduced species. Among parasitized trees, mistletoe prevalence is highest in the native Citharexylum fruticosum. The prevalence of D. caribaeus is higher in routes running trough pastures than areas with high tree cover. Conversely, D. caribaeus is more aggregated in areas with high tree cover than in pastures. This data provides evidence that patterns of tree infection by D. caribaeus are altered by land-use change.

Determinants factors of dung beetles species richness (Coleoptera Scarabaeidae) in semideciduous forest fragments from Lavras - Brazil.

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This work had the objective of studying some of the different factors that can be involved in the determination of the species richness of Scarabaeidae in forest fragments, as: a) forest fragments area and complexity. The study was carried out in 13 semideciduous forest fragments of Lavras, MG/Brazil. Scarabaeidae were collected using baited pitfall traps. The area of the fragment and their perimeter were used to calculate the complexity of the shape. These variables were related with the richness of species, the estimated richness (second order Jacknife). None of the measures of species richness were related to fragment area. However, the estimated species richness decreased with the increase of the complexity of the shape of the forest fragment; and b) the structure of vegetation and soil: Scarabaeidae collects, variables of vegetation structure and soil were done in 6 points of the 13 forest fragments

chosen for this specific study. The dataset were analyzed in distinct scales, one of them with the point as a sample unity and the other with the fragment itself. The environmental variables were ordered by a Principal Component Analysis (PCA) and the first two generated axis were then correlated with the richness of the Scarabaeidae species through a linear regression. The results demonstrate that the tenor of sand influenced negatively the species richness in both spatial scales. The variables of structure of the vegetation influenced in a distinct way the species richness of beetles in each scale. The main vegetation variables that had a relationship with the community of Scarabaeidae were the tree density, the spatial variation of the basal area and the height of the trees.

Effect of forest fragmentation on fruit and seed predation of the tropical dry forest tree Ceiba aesculifolia

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Forests fragmentation reduces the density of natural plant populations forming patches of the remaining individuals. One of the biotic interactions that can be affected by forest fragmentation and is poorly studied is seed predation. We determine the effects of forest fragmentation on seed and fruit predation in Ceiba aesculifolia by comparing trees in undisturbed forest with trees in disturbed forest. We compared the following variables: a) frequency of fruit predation by Collieïs squirrel (Sciurus colliaei) in each habitat; b) frequency of the cotton-staining bug seed predator (Dysdercus) in each habitat; c) the effect of seed predation on germination frequency and time; and d) the effect of different life stages of Dysdercus on seed viability. In undisturbed habitat 100% of the trees presented fruits with squirrel predation while only 34% of trees in disturbed habitats presented fruit predation. In undisturbed forest 27% of the trees contained fruits with the seed predator Dysdercus, while only 2% of the trees in disturbed forest presented Dysdercus . The initial weight of damaged seeds was greater than seeds that were not damaged indicating that seed predators select heavier seeds to feed upon. Frequency of seed germination was affected by different life stages; pre-adults decreased germination significantly more than nymphs and adults. Seed predation significantly increased the time it took for germination to occur. Our study shows that forest fragmentation significantly affects predation patterns of squirrels and cotton-staining bug. Reduction of natural seed predators in forest fragments may have long-term consequences on forest structure and diversity

Soil enzyme dynamics associated to C, N and P availability in a disturbed tropical dry ecosystem

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Soil fertility and biological activity measurements have been useful indicators for evaluate the recovery or degradation of biogeochemical processes in different ecosystems. Conversion of tropical dry forests to pastures results in severe degradation of soils and soil biogeochemical processes. However, the natural recovery of soil fertility and soil biogeochemical processes after many years of pasture use is largely unknown. We compared total and available C, N and P concentrations and the activity of three soil enzymes related to these nutrients: dehydrogenase (C), urease (N) and phosphatase (P) in primary forests (reference point for recovery), secondary forests with 6 years of previous pasture use and 26 years natural regeneration, and 26 year-old pastures. Two replicate sites of each land use type were located in the Chamela region near the Pacific Coast of Jalisco, Mexico. Soil samples were taken at four dates: the end of the dry season, the beginning, the middle and the end of the rainy season. The primary and secondary forests had higher total C, N, and P and available C than the pastures. Available N and P, and urease activity were strongly affected by season in all sites. Using the primary forest as a reference, secondary forests have recovered in terms of total nutrients and urease and phosphatase activities but these are still low in pastures of the same age. Variables related to phosphorus: total and available P and phosphatase, were better indicators of land use effects on soil biogeochemical processes in this tropical dry ecosystem than C and N variables.

Effects of tropical dry forest fragmentation on progeny vigor of Ceiba aesculifolia (Bombacaceae)

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Tropical dry forests are probably the most threatened systems in the tropics.
Fragmentation studies in tropical dry forests indicate that certain characteristics of these ecosystems can affect the establishment of the secondary forest. In addition fragmentation can have negative effects on the reproductive success of plants, pollinator activity, and/or seedling establishment and survivorship. We evaluated the effects of habitat fragmentation on seedling vigor of the tree Ceiba aesculifolia (Bombacaceae) in a Mexican tropical dry forest. We compared progenies of parental trees located in two habitat conditions: (1) fragmented tree populations in disturbed areas with 1 to 2 reproductive individuals per hectare and surrounded by agricultural fields or pastures and (2) non-fragmented tree populations of 5 or more reproductive individuals per hectare surrounded by undisturbed mature forest. Seeds were planted in a greenhouse and the following parameters were evaluated for each seedling in both habitat conditions: 1) probability of seed germination, 2) probability of seedling survivorship 7 days and 3) 180 days after germination, 4) relative growth rate (RGR) 5) biomass 6) developing time of the first leaf and 7) final seedling height and number of seedling leaves. Seeds obtained from fragmented tree populations were more likely to germinate than seeds from continuous populations. Seedling survivorships (7 or 180 days after germination) were not affected by habitat condition. The RGR obtained for seedlings belonging to trees was

approximately 0.8, indicating that Ceiba aesculifolia presents a quick growth in both habitat conditions. There were not significant differences between the developing time of the first leaf, seedling height, number of seedling leaves and biomass. We found a significant effect of maternal identity and seed weight on probability of seed germination and time of germination. Effects of fragmentation on germination will eventually have implications on seedling recruitment and populations demography of Ceiba aesculifolia.

The effects of habitat fragmentation on the interaction between larvae of Lepidoptera

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The species distribution and abundance are determined by several factors such as resource availability, genetics, weather and natural enemies. Present study focused on the relationships between Lepidoptera and Malpighiaceae species in two Cerrado fragments in Sao Paulo State. The following questions were addressed: 1) How similar is the caterpillar fauna among Malpighiaceae species? 2) What are the plant characteristics influencing Lepidoptera diversity? 3) Are Plant-Lepidoptera relationships kept on distinct fragments? Present data suggest that plants of different species of the same genus have not, necessarily, the highest faunal similarity, e.g., the high similarity among Byrsonima intermedia, Byrsonima coccolobifolia and Banisteriopsis pubipetala. No direct correlations were found among some plant characteristics such as nitrogen and tannin concentrations, trichome density and herbivory. But Malpighiaceae defenses probably influenced herbivore diversity, because Lepidoptera speciesï richness and abundance were related to these characteristics. Alkaloids and the specific fauna of Banisteriopsis stellaris support this suggestion. The caterpillar fauna similarity of 42,2% between fragments and some differences on nitrogen and tannin concentrations of the same species from distinct fragments suggest that environmental factors affect, considerably, plant phenotype and plant-herbivore interactions. Based on these results, some complementary studies were suggested to approach the complex relations between Lepidoptera and Malpighiaceae species.

Leafing phenology of abundant tree species in fragmented and continuous rain forests in Central Amazonia

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Plant phenology and its relationship with rainfall have been studied in tropical forests, but it remains poorly understood in the Amazonia. In this study leaf fall and flush were monthly monitored between February 2003 and December 2005 in two forests, a 10-ha fragment and a continuous forest, part of the BDFFP Project, both located 80 km north Manaus, Brazil. In each reserve about 20 trees (dbhƒ%¾10 cm) of each of the 18 most abundant tree species were individually observed for their phenological patterns, totaling 680 monitored trees. Protium altsonii, P. apiculatum, P. decandrum, P. hebetatum (Burseraceae), Hevea guianensis, Mabea speciosa (Euphorbiaceae), Swartzia reticulata, Paramachaerium ormosioides, Bocoa viridiflora (Fabaceae), Eschweilera coriacea, E. romeu-cardosoi, E. truncata, E. wachenheimii (Lecythidaceae), Scleronema micranthum (Malvaceae), Naucleopsis caloneura (Moraceae), Minquartia guianensis (Olacaceae), Ecclinusa guianensis (Sapotaceae) and Rinorea guianensis (Violaceae) were studied. Regardless seasonality, no phenological pattern was detected in terms of leaf fall for both fragment and continuous forests. Additionally, there was no relationship between frequency of trees falling leaves and monthly rainfall in none of the reserves (fragment rs=-0.09; p=0.58; continuous forest rs=-0.08; p=0.64). On the other hand, annual peak of leaf flush was consistently recorded between June and September, the end of the rainy season and the beginning of the dry season, in both reserves throughout the study period. Despite this tendency of periodical leaf flushes, frequency of trees producing new leaves and monthly rainfall correlated weakly in the fragment (rs=-0.36; p=0.03) and did not correlated in the continuous forest, suggesting that most of leaf flush depends on the accumulation of rainfall and an increase of light incidence in the beginning of the dry season to be triggered. Leaf fall, however, appears to be associated with stochastic local disturbances such as openness of treefall gaps and attack by leaf pathogens or gall-inducing insects.

Fragments of tropical rain forest on Tabasco, Mexico

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We studied the size, structure and composition fragments tropical rain forest state of Tabasco. The study was at Agua Blanca, Macuspana (200 m elev.), Villa Guadalupe, Huimanguillo (600 m .) and Ninos Heroes, Tenosique (400 m). This region rain fall is higher 3500 to 500 mm to year. At each site, all three species were censed in a 1-ha this area was subdivided four quarter ha. (25 plots, sample plot a square-100m2 in size).The vegetation in the fragments was presented various stages of regeneration of a tropical rain forest The composition of tropical rain forest: at Villa Guadalupe differs from other forest because was contained under canopy two arborescent ferns and tree canopy Simira salvadorensis, Nectandra ambinges and Quercus skinerii; Ninos Heroes, was presented tree species canopy Terminalia amazonia, Callophyllum brasilense, Dendropanax arboreus, Aspidosperma megalocarpon, Aspidosperma cruentum, Pouteria reticulate, middler canopy Oxandra maya, Talauma mexicana and Agua Blanca was presented middle canopy Aristolochia arborea, Decaxyz esparzae, Rechia

simplicifolia and tree species canopy Dialium guianense, Brosimum alicastrum and Ceiba pentandra.

Seed survival and germination and seedling density of a tropical tree (Dialium guianense) dispersed by howler monkeys in rainforest fragments in Northern Chiapas, Mexico

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The disappearance of primary seed dispersers in rainforest fragments can change plant community composition through effects on recruitment. However, empirical evidence remains scarce. We recorded seed survival time and germination, as well as seedling density Dialium guianense, whose main seed dispersers in Northern Chiapas, Mexico, are howler monkeys. During field experiments in rainforest fragments (4-10 ha, three inhabited and three uninhabited by monkeys), seed survival time was found to be longer in seeds placed in monkey dung (Mean 110.67, SD 7.0 days) and seeds in fruit and excluded from rodents and ants (Mean 108.33, SD 4.04 days), followed by seeds in fruit and with only rodents excluded (Mean 71.01, SD 32.08 days), and seeds in fruit accessible to all seed predators (Mean 53.67, 41.05 days). Location of seeds (parent trees vs monkey latrines) did not affect seed survival, nor were there differences in survival between fragments inhabited or not by monkeys. Seed germination was not observed in the field, but experiments performed in the laboratory showed germination rates was highest in mechanically scarified seeds (Mean 89.34, +/- SD 5.62 %), followed by seeds extracted from monkey dung (Mean 72.1, +/- SD 8.78 %), and non-scarified seeds (Mean 0.67, +/- SD 0.67 %). Seedling density was higher under real (Mean 0.37, +/- SD 1.04 ind/m2) vs simulated monkey latrines (Mean 0.04, +/- SD 0.24 ind/m2) or parent trees (Mean 0.08, +/- SD 0.33 ind/m2). Seeds appear to suffer less seed predation when found in monkey dung and a higher probability of germinating once they have traveled through the digestive tract of these animals, thus explaining the higher density of seedlings beneath monkey latrines. These results support the hypothesis that the loss of seed dispersers could have potential negative effects on populations of trees in forest fragments where monkeys have disappeared.

Genetic diversity of Tillandsia recurvata l. (Bromeliaceae) on their two main phorophytes at Zapotitlan Valley, Mexico

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The Tropical regions contain a high richness of typical epiphytes as bromeliads, orchids and ferns, but the genetic studies with these plants are insufficient to establish a potential pattern within this group. This study is a contribution to knowledge about the genetic diversity of one of the most abundant airplant species (Tillandsia recurvata) in the semiarid regions of Central Mexico. In this area this epiphyte uses the trees Prosopis laevigata and Parkinsonia praecox as its main phorophytes. The fieldwork of this study was conduced at Zapotitlan Valley, Puebla a large semiarid region of Central Mexico. In the present study, we analyzed the genetic diversity of T. recurvata in three populations, collecting at least 30 individuals of this epiphyte growing on Prosopis laevigata and Parkinsonia praecox. Samples were stored at -80øC for

genetic analysis. We used ordinary PCR conditions to amplify microsatellites regions using five primers designed in other published study. The electrophoretic analysis was conduced in ABI 3100 sequencer. Our results show a low number of heterocigotes individuals as a low polymorphism. The genetic differentiation among populations was low. These results may be originated by the high selfing (gene flow restricted) occurred within T. recurvata, instead a low small populations sizes of this epiphyte.

Natural hybridization between cassava and a wild relative: implications for conservation
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-- This abstract could also fit topics "Structure, function, and dynamics of tropical ecosystems " and "Tropical biodiversity and ecosystem conservation". --
Natural hybridization is common between crops and their wild relatives and raises important evolutionary, agronomic and conservation issues. Little work has addressed this issue for clonally propagated crops. Cassava (Manihot esculenta Crantz) is a good model for studying this question, as it is one of the most important clonally propagated crops in the tropics, and previous work has shown the importance of sexual reproduction under traditional management. Despite numerous zones of sympatry, natural hybridization has never been satisfactorily documented between cassava and a wild relative.
We studied two contact zones between cassava and a wild relative in French Guiana. In one of these sites, we showed, based on both morphological and genetic cues (ten morphological traits and six microsatellite loci), that introgression of domesticated cassava into its wild parent has in one site gone on extensively for at least three generations. Hybrids showed high vegetative vigour, suggesting heterosis effects. However, in the other site, hybridization is very limited, indicating that hybrids may grow mostly in favourable environments, with well-drained soils.
This suggests that hybridization between the crop and the wild relative present in French Guiana does not jeopardize the wild relative in the savannas where it usually grows, but is more of a problem in domesticated or otherwise disturbed environments.

Ecological and evolutionary implications of hybridization between transgenic virus-resistant cultivars of Cucurbita pepo and wild Cucurbita argyrosperma
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Ecological and evolutionary implications of hybridization between transgenic virus-resistant cultivars of Cucurbita pepo and wild Cucurbita argyrosperma

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The ecological and evolutionary implications of the escape of transgenic plants and their potential hybridization with wild relatives have rarely been studied. In this regard, it is of major importance to investigate the consequences of transgenic plant introductions, especially in countries like Mexico where important cultivars such as pumpkins (Cucurbita) have their center of origin, thus these introductions may affect this natural genetic variability reservoir. In this study, we evaluated the degree of hybridization and gene flow among transgenic virus-resistant cultivars of Cucurbita pepo and its wild relative Cucurbita argyrosperma sororia. We determined paternity and pollen performance with a design of controlled crosses, simulating different conditions of pollen competition. Paternity was estimated using both, molecular and phenotypic markers. Pollen performance was evaluated by observing pollen tube growth in the styles in vivo. We found that 2% of the progeny obtained by artificial pollination corresponds to transgenic hybrids. Furthermore, we observed that wild pollen tubes grow faster than transgenic tubes on wild C. argyrosperma pistils. These results indicate that gene flow between transgenic plants and their wild relatives is in deed possible, and the degree of hybridization is determined by the conditions of pollen competition.

Genetic diversity of Green Stick (Parkinsonia praecox, Leguminosae) a useful firewood specie in Colonia San Martin, Tehuacan Valley in Puebla, Mexico.

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Parkinsonia praecox is one of the most abundant tree specie in Tehuacan Valley, a semiarid region located at Central Mexico. This tree is widely used as firewood by local people. The impacts of human extraction on ecologic and genetic processes have been not studied in the populations of Tehuacan Valley. In the present study, we analyzed the genetic diversity of Green Stick in four populations that differ in the intensity of human use. We amplified microsatellite regions from cpDNA and nDNA using pimers designed for other plant species. We used PCR standard conditions to amplify these microsatellite regions that were run in ABI 3100 sequencer. We found a relative low genetic diversity and a deficiency of heterocigotes. However, we suppose that this low diversity is not caused directly by human use but probably by the reproductive system of Parkinsonia.

Diversity of fungus in Tabasco, Mexico

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The object was inventory mycology of state of Tabasco. Since 1984 two tousen specimens of macromycetes were collected. The new collection has 3500 specimens of two tousen species of Poliporales, Agaricales and Tremellales. These fungi were collected in: tropical rain forest (53%), secondary vegetation (23 %), agro ecosystems (17 %), wetland (5 %) and savanna (2%). The higher fungi growing under the shade of tree and among the litter of vascular plants:

75 % lignicolous, 14 humicolous 9 terricolous and 2 % finicolous. The Agaricales is the best represented. The new contribution to Tabasco Caripia montagnei, Auricularia delicada, Leucocoprinus birbaunii, Coprinus domesticus , Psatyrella stipatissima, Pseudomerulius aureus Sparassis crispa,Hydnochaete tabacina, Hymenochaete badio-ferruginea and Phellinus fastuosus.

Comparing the genetic diversity of Prosopis laevigata (Smooth Mesquite) in four natural populations, whith different extraction levels in Colonia San Martin, in Puebla, Mexico.

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The genus Prosopis is one of the most important resources in arid and semiarid regions of the world. This study focused on the woody specie Prosopis laevigata (Smooth Mesquite), which Mexican populations range from Sonora to Oaxaca. This specie has many uses, as firewood and construction material mainly, within rural communities. That firewood also serves as a trade item to interchange for food and other goods. In some regions of Mexico, this specie has great social, economic and cultural value; hence its overexploitation may occur, as is around Colonia San Martin, in Puebla. Genetic and ecological studies are limited and they results insufficient to establish a long term management planning. This study is a contribution to knowledge about the genetic diversity of P. laevigata from wild populations, to try to identify the main threats on this resource and to support future management and conservation programs. Our field study sites are close to the Colonia San Martin community, which locates at Zapotitlan Valley, in the Mexican state of Puebla. We collected leaf samples of 30 healthy individuals of Mesquite, from four wild populations which differ in its use intensity. Genomic DNA was isolated applying a standard SDS-phenol protocol. Six microsatellite regions were amplified using primers designed in other published study. These primers were fluorescent labeled and run in capillary electrophoresis system ABI 3100 genetic analyzer. Our results show consistency with the published data. The locus Mo07 shows 9 alleles that generate 14 different genotypes; observed heterozygosity was 0.74, while expected heterozygosity is 0.78. Sexual reproduction and outcrossed mating system were predominantly for this genus; these features make feasible to expect a high degree of variability within populations and a low level of differentiation between populations. Plus, we expected to know what individuals have more capability to form heterocigotic breeding lines.

Evolutionary origins of a rain forest endemic: phylogeny and biogeography of the ant genus leptomyrmex (hymenoptera: formicidae)

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Rainforest diversity is often considered in relation to current ecosystem parameters, however, diversification within a lineage may have occurred in a climate or community context that differed markedly from present conditions. Determining the geography and timing of diversification contributes to a better understanding the evolution of endemic taxa and their biogeographic history. Ants of the genus Leptomyrmex occur only in the rain forest of eastern Australia, New Guinea and New Caledonia. Fossils from 20 million year-old Dominican amber suggest that they may once have been widespread across Gondwana, and suffered near-

complete extinction throughout their former range, with the exception of the remnant Australasian forests. Phylogenetic reconstructions using three nuclear genes (28S, Long wavelength rhodopsin, Wingless and Arginine Kinase) from thirty-three ingroup and three outgroup taxa provide support for this evolutionary scenario and further indicate a phylogenetic influence on the current ranges of extant species groups. The importance of these findings for rainforest taxa, and the value of using flightless invertebrates as ƒ?~surrogatesƒ?T for endemism are discussed.

Forest estructure and dynamics

MONDAY JULY 16

The Paradox of Generalist Species
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The ecological mechanisms of species coexistence in highly diverse tropical rain forest remain unresolved. The niche-assembly hypothesis states that species partition a heterogeneous environment along several abiotic and biotic axes, allowing coexistence through specialisation. This theory is supported by evidence for specialisation among tropical trees on different soil types. A fundamental challenge to this theory is the common occurrence of trees that are soil generalists. Ecological theory predicts that generalists in any particular environment are excluded by specialists, yet in tropical Asian dipterocarp forests, closely related generalists co-occur with specialists. A possible explanation for this is that partitioning of niche-space involves multiple trade-offs that include interactions between the abiotic and biotic environment.
I am exploring the performance of seedlings of six Shorea (Dipterocarpaceae) species, using four specialists (two on each of two soil types) and two soil generalists, in a reciprocal transplant design in the Sepilok Forest Reserve (Malaysia). I am quantifying, under different soil and light conditions, the performance of these seedlings in terms of mortality, growth, investment in defence compounds, susceptibility to herbivory, mycorrhizal associations and the interactions of all these variables.
I predict that trade-offs exist such that specialists adapted to particular soil types have higher growth rates than generalists but are more susceptible to herbivory, or depend on a more restricted set of mycorrhizal species that may limit initial establishment - and that it is these trade-offs that allow coexistence.

Tree functional trait variation in a biogeographically complex Mexican mountain cloud forest
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Morpho-functional traits largely determine a species*ƒ*?T ecological strategy. Four of such traits are ecologically very relevant: (a) specific leaf area (SLA), (b) height at maturity (Hmax), (c) wood density (WD), and (d) seed mass (SM). Our goal was to examine overall variation in these traits and to identify functional groups among 33 tree species from a Mesoamerican montane cloud forest, where species with different ecological and biogeographical affinities coexist. A phylogenetic tree was used as working hypothesis for the examination of the effect of phylogeny on correlations between attributes. To explore patterns of multiple covariation among the four traits we used Principal Component Analysis (PCA). We constructed a dendrogram through Wardïs linkage method and Euclidian distances. To evaluate bivariate trait

relationships we used: (1) cross-species correlations, and (2) evolutionary divergence correlations analysis using phylogenetically independent contrasts (PICs). Correlations among attribute pairs were weak, the single most obvious one being between Hmax and SM, followed by a less strong correlation between Hmax and WD. This latter character pair was also correlated in PICs when phylogeny was considered; the former pair was not significantly correlated but showed a clear trend. In both analyses SLA was unrelated to all other traits. The first two axes of the PCA ordination explained together 66.9% of between-species variation. Although this variation was largely continuous, species clustering allowed to differentiate two main groups. The observed trait correlations were consistent with those reported for other floras, excepting the independent behavior of SLA. Despite the mixture of biogeographical histories, the effect of phylogeny in the covariation of the functional attributes was unimportant: in several groups a mixture of clades was represented among species, suggesting convergence of many lineages.

Carbon and nitrogen pools in above- and belowground phytomass of secondary tropical dry forests after abandonment of different land uses

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We compared carbon (C) and nitrogen (N) pools in total above- (TAGB) and belowground (TBGB) phytomass of secondary tropical dry forests, growing in sites cleared by bulldozer 30 years ago and subjected to different land uses prior to abandonment: a) housing development (HD), b) pasture (P), and c) no use (NU). We estimated TABG in two forest sites representing each of the three former land-use types (i.e., a total of six sites) and TBGB in the two NU forest sites. TAGB ranged from 42 to 55 Mg/ha and did not differ significantly among land-use types. Biomass in the 1-3 cm dbh size-class was significantly higher in NU than in HD and P. Total dead biomass differed significantly between the NU (14 Mg/ha) and P (7 Mg/ha) land-use types, but aboveground live biomass did not (range from 36 to 42 Mg/ha). Total C pools in biomass varied from 18 to 23 Mg/ha and did not differ among land use types. The NU land use showed the highest total aboveground N pool (218 kg/ha) compared to 142 and 135 kg/ha in HD and P, respectively. Total root biomass and C and N pools were 6.9 ñ 1 Mg/ha, 5.1 ñ 0.8 MgC/ha, and 138.1 ñ 17.5 kgN/ha in NU (mean ñ SD). After 30 years of regeneration, these secondary forests represent at most 55% of the TAGB, 45% of the TBGB, and 39% of the aboveground C and N pools.

Population dynamics of Manilkara zapota (L.) Royen in a subtropical rain forest

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We conducted an analysis on the population dynamics of Manilkara zapota by means of population projection matrices to understand the persistence and dominance of this species in a subtropical rain forest from central Veracruz, Mexico. The population of M. zapota was structured in 11 different stages over which we made evaluations of survival, growth, and reproduction for two consecutive years. Conventional projection matrix analyses (i.e. elasticity and sensibility analyses) were performed on the survival, growth, and fecundity throughout the stages. In addition, we conducted a perturbation analysis based on standardized variance of

each element of the projection matrices to identify which demographic processes is the most important influencing the population dynamics of this species. The asymptotic growth rate of the population differed among years (lambda-yr1=0.98, and lambda-yr2=1.02), due to scarce reproduction in the first year. The elasticity values indicate that parameters with major influence over the population growth rate were the stasis of both adults and juvenile pre-reproductive stages. In contrast, the perturbation analysis standardized in the variance identified the survival of young juveniles and the seedling stages like the most important demographic parameters influencing the variation of lambda. These findings are relevant since M. zapota tends to develop an abundant seedling bank on which some conservation strategies can be suggested to promote the persistence of the species.

Estimations of Carbon stocks, C-sequestration and C-turnover in the aboveground wood biomass of black-water floodplain forests in Central Amazonia

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Tropical floodplain forests play an important role in the biogeochemical cycles, however, little is known about the amount of carbon that these forests are able to store. In this study, we estimate aboveground woody biomass (AGWB), carbon stock and sink, and residence time of carbon in biomass in three flooding levels of the nutrient-poor black-water floodplain forests (igapo) of the Amana Sustainable Development Reserve, Central Amazonia. Dendrochronological methods were applied to determine forest age, annual radial increment and wood density of tree species. To collect data, we used eleven 625-m2 plots where all trees with DBH ƒ%¾ 10 cm (diameter at breast height) were identified and measured in DBH and height. AGWB estimations were made using three allometric regression models by DBH, wood density and tree height. We observed a change on floristic composition and an increase on species richness along the gradient of inundation. Estimated stand age varies between 261 and 337 years. In average, low igapo (forests flooded for 5-7 m per year) presented biomass of 180 Mg/ha, which is significantly fewer than middle (flood height of 3-5 m) and high (flood-height of 1-3 m) igapo (232 and 229 Mg/ha, respectively), carbon stock (estimated by 50% of AGWB) was 90, 116 and 115 Mg C/ha in the low, middle and high igapo, respectively. Carbon sequestration increased from 1.2 in the low igapo to 2.0 Mg C/ha/year in the high igapo, but mean residence time of carbon in the AGWB did not differ significantly among igapos (54, 57 and 78 years). Compared to high productive varzeas (nutrient-rich floodplains), the igapos of Amana present a slow growth dynamic and therefore a low potential for timber exploitation. Further studies evaluating growth in species level are required to a better understanding of the carbon dynamics of this igapo.

Tropy-dry

MONDAY JULY 16

Assessing the vertical structure of the woody material in the Tropical Dry Forest through LIDAR and Hyper spectral remote sensing

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Secondary forests are regarded as reservoirs of biodiversity and as regulators of important ecological, hydrologic and biogeochemical processes. In addition forest secondary growth is considered by many scientists as a potential source of carbon sequestration. These are some of the reasons why a lot of effort has been devoted by the scientific community in mapping these regions, particularly in the Neotropics.
Forest vertical structure is the arrangement of canopy layers, foliage, woody material and the presence of liana (vines) along the canopy. Ecologists have reported that successional stages are related to particular patterns on these variables. In the Tropical Dry Forest (TDF) at the leaf off condition these characteristics can provide a key for identification of successional stages. Remote sensing technologies such as LIDAR (Light Detection and Ranging) and hyper spectral remote sensing have been used recently in Tropical Rain Forests for this goal, but very few studies have been conducted in the Tropical Dry Forest yet. The leaf off condition at the TDF is a challenge to "traditional" broadband remote sensors, since the forest upper canopy loose most of the leaves at that season, and therefore biomass-related indices such as NDVI or LAI are difficult to estimate.
This project focuses on study the capability of the LVIS (LIDAR sensor) and HYMAP (hyper spectral) sensors to detect several stages of secondary growth in the Santa Rosa National Park, Costa Rica. The LVIS sensor produces a full reflective history of the surfaces that intercept the laser beam. By analyzing this ƒ?osignatureƒ?? it could be possible to identify different vertical arrangements of woody materials that characterize stages of the secondary growth. Hyper spectral information from the HYMAP data can be used to detect the presence / absence of lianas in leaf of patches of TDF canopy as well

Restoration of tropical dry forests in Margarita Island, Venezuela: Countering arrested succession

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Open-sky sand mining causes the removal of vegetation along seasonal creeks in the Macanao Peninsula, Margarita Island, Venezuela. We evaluated tropical dry forest succession in an abandoned sand mine, in sectors with varying exploitation intensities and different lengths of time since perturbation ceased. In addition to these factors, we also considered the distance to a source of propagules and the conditions of the soil, to try to explain observed vegetation

patterns. While time since abandonment had a low explanatory power, distance to a source of propagules conditioned the advance of the successional process both in terms of species composition and community structure: the farther away that a recovering site was from a source of propagules, the simpler its structure and the higher the dominance of early succession species. Under these conditions, the succession was arrested, or it advanced very slowly. To understand the successional process in greater detail, we analyzed the relative importance of the seed bank, seed rain, and soil nutrient level. The seed rain appeared to be potentially the most important potential source of propagules (the seed bank was very poor), but once seeds arrived at a disturbed site, although soil nutrient levels seemed adequate, germination rates were very low. Other factors not considered in this study, such as seed and seedling predation, competition with grasses, and high surface temperatures, may partially explain low germination rates. Given that natural regeneration seemed unlikely or extremely slow, we raised seedlings in a greenhouse and planted them in the field under different water and nutrient conditions. Water seemed to be the primary limiting factor, as the most successful treatment in terms of growth and survival of seedlings in the field was the application of a hydrogel that retained and supplied water to the plant over several weeks

Tropi-Dry Brazil: a multidisciplinary, long-term study in the threatened Brazilian tropical dry forests

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As a part of the collaborative research network called ƒ?oTropi-Dryƒ??, several human, biophysical and ecological aspects are under investigation in a tropical dry forest in Southeastern Brazil, in the State of Minas Gerais. The study site is the State Park of Mata Seca (SPMS), a conservation unit with 10,281.44 ha located in the valley of the SÆo Francisco River, between 14ø48ƒ?T36ƒ?? ƒ?" 14ø56ƒ?T59ƒ?? S and 43ø55ƒ?T12ƒ?? ƒ?" 44ø04ƒ?T12ƒ?? W. The main economic activities in the area before protection were cattle raising and bean and corn plantations. Approximately 1,525 ha of the SPMS are covered with abandoned pasture fields in different regeneration stages, and the remaining area supports secondary and primary dry forests. The main goal of this study is to understand the processes influencing the natural regeneration of tropical dry forests. In this sense, the ecological and biophysical studies are designed to compare several variables across a successional gradient: abandoned pastures, early, intermediate and late stages. The ecological component includes tree and liana structure and composition, plant phenology and pollination syndromes, seed dispersal by birds and bats, biomass production, seed recruitment and herbivory. The biophysical component includes the production of maps of forest succession and structure using satellite imagery and ground-truth data. Data obtained in these two dimensions will be integrated to the information gathered by the social dimension on land-use history and demographic and economical variables from human settlements in the buffer zone of the SPMS. Further, the data will be compared to those obtained in three other countries: Costa Rica, M,xico and Venezuela. The results of this multidisciplinary study will be used to propose conservation and management policies that promote the sustainable use of tropical dry forests in Brazil and across the Americas.

Diversity of tree-dwelling ants along a successional gradient of a seasonally dry tropical forest in Brazil.

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Diversity and composition of tree-dwelling ants were compared on different successional stages during the wet and dry seasons of a seasonally dry tropical forest in southeastern Brazil. The study was carried out in the Parque Estadual Mata Seca, northern Minas Gerais state. The sampling of the ants was performed on three forest areas: a five-year old regeneration area (early); a fifteen-year old area (intermediate), and a primary forest (late). The richness of ant morphospecies was not influenced by successional stage or season. However, by using a principal component analysis (PCA), the plots from the early stage were isolated from the other stages, intermediate and late, indicating there is a change on the composition of ant morphospecies as one moves forward the successional stages. The results indicate that tree-dwelling ants may be used as indicators of successional change in seasonally tropical dry forests.

Sex-biased folivory in Spondias purpurea: importance of chemical quality and leaf age

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The level of herbivory damage on leaves could depend on different characters of the leaf, like age, nutritional quality and chemical plant defense. In dioecious plants, the resource allocation theory predicts that female plants allocate more resources to plant reproduction and the defense than male plants, and fewer resources to other functions like growth rate. Therefore, it is possible to expect differences in the levels of herbivory among both sexes. In this study, we determined the plant defense and nutritional quality on young and mature leaves and its relationship with the folivory on male and female individuals of a dioecious tree, Spondias purpurea, in a tropical dry forest. If the female trees allocate more resources to reproduction, we expected that females could have a poorly nutritional quality and be better defended than males. Consequently, the female trees could have lower levels of folivory than male trees. The folivory was measured analyzing digital images of 7200 leaves of female and male trees, and we used spectrophotometric techniques to determine the chemical quality of the leaves. Our results demonstrated the females had higher percentages of leaf area removed by insects. We also found significant differences in the levels of herbivory between young and mature leaves in female and male trees. The secondary metabolites concentrations were similar between male and females trees. The mature leaves had higher concentration of hydrolizable tannins and elagitannins than young leaves. The nutritional quality measured as water, non-structural carbohydrates and chlorophyll concentration. The female trees had higher levels of chlorophyll than the male trees. Apparently, the chemical defense has non importance in the female-biased folivory of Spondias purpurea, while the nutritional quality can explain this pattern. Finally, despite the general tendency of a male-biased herbivory, appears to be a common pattern, our

study do not support this hypothesis.

State of tree species with reduced populations or in danger of extinction in the dry forest of Guanacaste, Costa Rica

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We selected 8 tree species of the Guanacaste dry and moist forests which suffered population decline during the last decades due to elevated rates of commercial timber harvesting. We considered pollination mechanisms, seed dispersal, regional range distribution, endemism, abundance, frequency and current regeneration rates of these species as critical factors for population stability. We evaluated 150 plots distributed in 3 classes (pastures, secondary and gallery forests) nested in 3 regions. We considered also the plot land use history and management. In each plot of 30 x 50 meters we did a composition and structural analysis measuring all trees above 5 cm of DBH. The tree species with the highest density for the secondary and gallery forests corresponded to Anacardium excelsum and the higher density for pastures to Cedrela odorata. Furthermore, Dalbergia retusa, Hymenaea courbaril and Sideroxylon capiri presented low densities for the gallery forests. Nevertheless, the greater densities for the last three species species were found whithin the state-protected secondary forests which have the minimum conditions for the recovery of these species. Also, in private protected areas we found excellent regeneration rates for Astronium graveolens, D. retusa, H. courbaril, S. capiri and C. odorata. Pasture lands were unfavorable for restoration of these species due to a low gene flow capacity among isolated individuals. Given the differences in restoration rates between unprotected and protected private or state land, we suggest prioritizing the establishment of protected zones to preserve tree species and associated wild life. In addition we recommend the development of a restoration strategy for the preservation of trees with high risk of extinction. The prohibition of D. retusa, S. capiri, A. graveolens and H. courbaril harvesting and the establishment of better harvesting control for the C. pentandra and A. excelsum is recommended.

Tree species populations in Area de Conservación Tempisque (ACT) Guanacaste Costa Rica

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Timber harvesting impact was evaluated in ACT in terms of the state of vegetal species populations by establishing 150 temporary plots distributed in 3 forest classes: gallery, disturbed and secondary. Secondary forests showed great diversity and presented a floral composition related to natural succession. Disturbed forests are also diverse but with a greater human impact because the absence of regulation plans. Gallery forests displayed a dominance of species associated with riparian ecosystem. Population levels of timber species are very irregular and do not present an acceptable diametrical distribution. The current sizes of species populations can not guarantee the perpetuity of them in the ecosystems. In addition, natural regeneration displays deficiencies in tree densities due to the human impact (e.g. timber harvesting, cattle grazing. and fires). The high tree population decline by human impact and the low natural population densities of these species are two factors determining the sustainability to these tree populations. Most of the forest landscape of this region is very fragmented and hence in order to allow a good genetic flow connectivity must be improved. According to the

measured variables and literature, species used for timber harvesting are classified in extremely critical levels and are candidates to be declared in extinction risk. Only 4 species are protected by the state regulations: Guaiacum sanctum, Swietenia macrophylla, Cordia gerascanthus and Platymiscium parviflorum. Nevertheless, it is recommended to included in the this list 17 additional species (e.g. Couropita nicaraguensis, Astronium graveolens, Dalbergia retusa, Courbaril Hymenaea, Manilkara chicle, Manilkara zapota, Sideroxylon capiri, Albizia niopoides, Hura crepitans, Maclura tinctoria, Ceiba pentandra). Therefore it is necessary to develop a strategy with the goals of promoting natural restoration, protection and enrichment of disturbed and gallery forests, as well as the establishment of forest plantations

Tropi-Dry Venezuela: A proposal to study the biophysical and human dimensions of dry forests in the north-central Llanos region.
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The Venezuelan chapter of the Tropi-Dry research network aims to study dry forest succession and human-forest interactions in a matrix of savannas, secondary and primary forests located in the north-central Llanos region of Venezuela. The study site is located within Hato Pi¤ero, a 75,000 ha private property in which cattle ranching has been successfully combined with tourism and research for long-term biodiversity conservation. Biophysical characterization of four succesional stages of the dry forest, from pastures to > 50 year-old forest, will be conducted using 12 experimental 30 x 60 m plots, considering three replicates for each succesional stage. Ecological characterization of the plots will include: floristic composition, community physiognomy and structure, soil and mycorrhizae properties, reproductive and foliage phenology, leaf litter, plant reproductive attributes, seed dispersal, and herbivory. A time series of satellite images (Landsat and Aster), will be used to examine general fragmentation and landcover patterns in the ranch, as well as to monitor forest succession in our experimental plots. Remote sensing data will be integrated to field measurement of ecological variables. The area of influence of two human settlements near the study site, El Ba£l and El Pao, was defined on the basis of geographic distance of these settlements to the main forest tracts in Hato Pi¤ero, and the main socioeconomic activities identified in the region. A standardized census/population database will be obtained from the area of influence. A series of interviews and study cases will be conducted to determine local knowledge on dry forests and to reconstruct the policies related to their use. This region is part of a national development plan that could affect the future of remnant forest patches. The results of this study will be used to help orient in the formulation of dry forest sustainable use policies in the region

Does seed dispersal at the late dry season limit seedling establishment of dry-forest trees?
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We examined the following hipothesis: (i) seeds of dry forest trees have high pre- and post-germination mortality by desiccation due to the time between seed dispersal and germination and due to irregular rains at the onset of the rainy season; (ii) seedlings from seeds dispersed in the dry season which survive to the dry spells are higher at the end of the first rainy season than that dispersed in the rainy season because the former have more time to grow. We

evaluated the possible trade-off between many small seedlings (natural dispersal) Ç- few high seedlings (delayed dispersal) on the seedling survival during the dry season. We sowed eight tree species in green-house, simulating the natural dispersal and when rains are more constant. Once shading can counteract the effects of desiccation, we applied three levels of shading (10%, 40% and 72% of PPFD). We applied the daily precipitation of a median year from a major patch of dry forests in Central Brazil. At the end of the rainy season, part of the seedlings was collected for growth measurements (dry mass) and part was left to follow the dry season survivorship. The lower germination expected for seeds dispersed in the dry season and in full sun was not confirmed for species that had some dormancy. The delayed dispersal was advantageous for the initial establishment on fast germinating species, but it was irrelevant or even disadvantageous for others. Also, the green-house weather was certainly milder than in the natural environment, reducing the potential mortality by desiccation. The growth of the four species of higher dormancy were not affected by timing of seed dispersal, while three out of four fast germinating species had higher root biomass when dispersed in the dry season. The growth during the rainy season did not affect seedling survival during the dry season. Keeping seeds to sow when rain is constant might be a good strategy to increase the establishment of fast-germinating tree species

Mata Seca State Park, Northern Minas Gerais, Brazil: territory, human populations and biodiversity in a seasonally dry tropical forest.

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The Mata Seca State Park (MSSP), situated in a semi-arid part of Southeastern Brazil, in the Minas Gerais State, has 10,281.44 hectares covered with seasonally dry forests. Knowledge on the social context of a protected conservation unit is very important to define potential threats, such as fire and hunting, and population rewards such as ecotourism and increment of the local economy. This study aimed to characterize the human occupation in the buffer area of this conservation unit, in order to develop management strategies for the MSSP. The buffer area of the park is legally defined as 10 km surrounding its limits and, from the human point of view, is considered the park*ƒ*?Ts zone of influence. We encountered four cities partially encompassed by the zone of influence, meaning that the park affects 58,244 people. Among these people, 43% leave in rural areas, including 11 communities with 810 families (4,050 people) belonging to traditional populations, such as slave-descendents, indigenes and dwellers of river margins. The Human Development Index (HDI) indicated values between 0.595 and 0.622 for the cities inside the zone of influence of the MSSP, which can be considered as areas of low human development. 53% of the economically active population are involved in cattle raising, agriculture and fishing. However, the main land use in the buffer zone of the MSSP is the extensive cattle raising, which occupies 49% of the area in large farms with natural and planted pastures. This activity increases the fire proneness in the surroundings of the park and, together with illegal hunting and fishing, is the main threat to the biodiversity in the MSSP. We suggest that a management plan for this conservation unit may consider alternative, less disturbing economic activities for the region, in accordance to the traditional practices of the local populations

Loss of carbon sequestration potential after several decades of shifting cultivation in the southern Yucatan.

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In a system dependent on biomass burning for nutrient inputs, recovery of aboveground biomass is critical for continued land use. In addition, maintenance and mineralization of soil organic matter is essential for conserving and recycling nutrients locally. Cumulative losses from these pools can also affect the balance of global carbon and nutrient cycles. We determined whether shifting cultivation in the Southern Yucat n Peninsular Region (SYPR) causes feedbacks that limit future productivity and carbon sequestration potential. Specifically, we tested whether the number of prior cultivation-fallow cycles affects the recovery of carbon stocks. Live aboveground biomass, coarse woody debris, fine woody debris, forest floor litter, and soil were sampled in 53 sites (39 secondary forests 2-25 years old and 14 mature forests) along a precipitation gradient in Campeche and Quintana Roo, Mexico. Estimated aboveground and soil carbon stocks (to 1 m) ranged from 192 Mg ha-1 in 12 year old secondary forest to 468 Mg ha-1 in mature forest. Mean carbon stocks in live aboveground biomass and coarse woody debris declined 38% and 85%, respectively, from the first to the third cultivation-fallow cycle. Thus inputs to soil carbon declined with each cycle, but soil carbon itself had not yet responded after three cycles. The combined aboveground and soil carbon stock declined almost 30% after the first cultivation, however repeated cultivations did not promote another significant decline. On average, 79% of combined aboveground and soil carbon resulted from soils in mature forest, in comparison with 91% in the youngest secondary forests. Although age was the dominant factor in predicting the carbon stocks of secondary forests under shifting cultivation, the number of prior cycles should not be neglected. Accurately quantifying carbon fluxes from land-use change, evaluating alternatives for carbon sequestration, and modeling human responses to changing productivity under shifting cultivation depend on incorporating the effects of land-use history

Canopy herbivory in a dry forest-cerrado transition in Brazil.

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This study aimed to compare the diversity of canopy herbivore insects and their damage along a dry forest-cerrado (savanna) abrupt transition in southeastern Brazil. We delimited two linear transects of 750 m across both habitats and, at each 50m, the closest tree with circumference at breast height ƒ%¾ 15 cm was selected. In the dry forest, the canopy was reached with single rope climbing technique, whereas the shorter canopy of the cerrado was assessed with an aluminum ladder. Insects were collected with an entomological umbrella, and 20 leaves were collected to calculate the leaf specific mass and leaf area loss through herbivory. Also, we

collected 10 soils samples from each habitat to determine soil nutrient content. We sampled 135 herbivorous insects, representing 54 morphospecies, mostly in dry forest trees (112 individuals belonging to 41 species). A higher abundance of chewing and sap-sucking insects were observed n dry forest trees. The same pattern was observed for chewers richness, but not for sap-suckers. No difference was observed on the richness of sap-sucking insects between habitats, but their abundance was significantly higher on dry forest trees. Herbivorous insects were not affected by leaf specific mass regardless of guild and habitat, except for the abundance of sap-sucking insects in the dry forest. However, we observed a negative correlation between the herbivory rate and the specific leaf mass. Cerrado trees showed a higher specific leaf mass and lower herbivory rates than those occurring in the dry forest. All soil variables showed higher concentrations on the dry forest than in the cerrado, except remainder phosphorus. These results suggest that herbivory rates in the transition dry forest-cerrado may be driven by soil nutrient content and plant strategies to save water, which are thought to influence leaf sclerophylly.

Phenological patterns of trees under different successional stages of a Tropical Dry Forest
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Secondary successional stages are likely to be the most frequent state of tropical dry forests in the next decades. However, changes in phenological patterns of plant communities occurring during succession have been poorly studied. We characterize tree phenology (i.e. vegetative and reproductive phenophases) of a tropical dry forest of the Chamela-Cuixmala region (Pacific coast of Mexico). This information will allow us to understand and predict the consequences of disturbance on the phenological expressions of plants, which are key to the regeneration of tropical dry forests. For this purpose we selected nine 50*20 m plots representing three different successional stages (early, intermediate and late) of this tropical system. We then delimited two 50 * 3 m transects in each plot and labeled all trees above 2.5 cm of diameter at breast height occurring in these transects. Every month, during one year of observations (2006-2007), phenology of all marked individuals was monitored for presence/absence of different phenophases (green leaves, floral buds, flowers and fruits). In addition to record presence/absence data, we estimated percent coverage of each phenophase in order to be able to describe periodicity, frequency and duration of each phenophase. Percent coverage was categorized sensu Fournier (1978). Preliminary data analysis for 89 species, suggests that phenological patterns vary among different successional stages at the community and species level. Flower and fruit phenophases are more pronouncedly expressed in late successional than early stages, while flowering and fruiting periods started earlier and were maintained for a longer period in early successional stages.

Pollination Ecology of Ipomoea ampullacea In The Tropical Dry Forest of Chamela-Cuixmala
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The efficiency of bats as pollinators has been a subject of considerable research in Tropical Rain Forests but not as much in the Tropical Dry Forests, one of the most threatened ecosystems in Mexico. More studies are required to understand the role that bat pollinators play in the functioning of this particular system. As stated by floral syndrome theory, floral traits of I. ampullaceae correspond mainly to bat pollination, although sphingids and hummingbirds have also been recorded as important flower visitors. The aim of this study is to assess the relative efficiency of these three pollinator groups in the reproductive success of I. ampullacea. We compared visitation frequencies, frequency of effective pollinations, pollen deposition on stigmas, frequency of pollen tubes in styles, and male and female plant reproductive success promoted by each pollinator group. We filmed flowers of I. ampullacea throughout the anthesis period, being able to determine the visitation peak period. With this information we conducted exclusion experiments to assess the relative contribution of each group to effective pollination. Also, we determined the breeding system of I. ampullacea by performing three pollination treatments: hand-crossed pollination, autonomous self-pollination and control flowers exposed to natural pollinators. Female reproductive success as well as pollen loads on stigmas and pollen tube growth was assessed in each treatment. Male reproductive success was evaluated as the proportion of pollen removed in naturally pollinated senesced flowers. The combination of these experiments allowed us to evaluate the contributions of each of these groups of pollinators in the different stages of the pollination and reproductive success of I. ampullaceae. Preliminary results showed that bats are the most efficient pollinators, and also that this species is pollen limited. We discuss the implication of these results for the reproductive dynamics of I. ampullacea.

Pollination of three sympatric species of Ipomoea (Convolvulaceae) in Chamela-Cuixmala tropical dry forest in western, Mexico

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Plant-pollinator interactions may be influenced by the composition of the flowering plant community. Sympatric species that bloom synchronously and share pollinators have developed mechanisms to avoid competition including divergence in flowering time, differential pollen placement on the body of pollinators and floral morphological specialization. In this study we examined pollinator assemblages of three sympatric Ipomoea species with similar floral characteristics such as color, shape and time to anthesis. In order to determine the reproductive strategies of I. alba, I. ampullacea and I. wolcottiana, we studied flowering phenology, flowering time, volume and sugar concentration of nectar, flower morphometric measurements. In order to determine the relationship between these traits with the effective pollinators, we filmed flower visitors during the reproductive period of each plant species. The flowering period of the three Ipomoea species overlap during four months; on a daily level,

there was almost a complete overlap between I. alba and I. ampullacea, their flowers opened between 1900 and closed at 0600 and 0900 respectively. In contrast, the flowers of I. wolcottiana began opening around 0000 hours and remained open until midday. There was considerable variation in the quantity and quality of nectar produced between species, being I. wolcottiana the species that produced the most concentrated and less quantity of nectar, while I. alba and I. ampullacea produced less concentrated nectar and greater volume. Morphometric measurements also showed significant variation in corolla tube length among the three species. The pollinator fauna of I. wolcottiana were bees and wasps, for I. ampullacea bats, sphinghids and hummingbirds and there were not visitors for I. alba.
Even though flower morphology seems to be similar between species, our study demonstrates that several traits differed between species and are specialized for particular pollinators.

Herbivory

TUESDAY JULY 17

Antiherbivore protection by mutualistic spiders and the role of plant glandular trichomes

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Although specific associations between spiders and particular plant types have been reported for several taxonomic groups, their consequences for spiders and plants are yet poorly known. The most common South-American lynx spiders Peucetia flava and P. rubrolineata live strictly associated with various plant species bearing glandular trichomes. To better understand these spider-plant relationships, we investigated the influence of the spiders on the fitness of a Neotropical glandular shrub, as well as on the whole arthropod community on the plant. In addition, we tested whether glandular hairs provide benefit to the spiders. Spiders reduced the abundance of several species and guilds of herbivores on the leaves and inflorescences. Consequently, plant damages on the leaves, capitula, ovaries, corollas and stigmas caused by leaf mining and chewing insects, as well as endophagous insects, were strongly reduced in the presence of Peucetia spp. Despite the spiders have fed on flower visitors, their negative influence on the ovule fertilization was only marginally non-significant ($P = 0.065$). While spiders on plants of T. adenantha have fed on dead common fruit flies adhered to the glandular trichomes and did not lost body mass, the spiders on plants without glandular trichomes (Melissa officinalis) did not feed on dead flies and lost 13-20% of their biomass. Our results indicate that Peucetia spiders are effective plant body-guards, and under live prey scarcity they may feed on insect carcasses adhered to the glandular trichomes. Since several spider species of the genus Peucetia live strictly associated with plants bearing glandular trichomes in the Neotropical, Neartic, Paleartic and Afrotropical regions, this type of facultative mutualism involving Peucetia and glandular plants may be common worldwide.

Strategies of Chlosyne lacinia caterpillars (Nymphalidae) to survive feeding on the toxic plant Thitonia diversifolia (Asteraceae).

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Chlosyne lacinia is a common species from Heliantheae. Their leaves bear glandular trichomes, which contain sesquiterpene lactones. These secondary compounds are known to have strong effects against many larvae of lepidopterous species, including the reduction of the rate of larval growth and reduction of survival. The aims of this study were to evaluate the

behavioral and physiological mechanisms related to the herbivory of the caterpillars in leaves of Tithonia diversifolia. The size, weight, rate of food consumption, rate of growth, and efficiency of assimilation of the food in each larval stage of the development were measured. We also analyzed the trichome density and lactones compounds of T. diversifolia. The larval foraging behavior was observed. Then, we carried out a bioassay about the effects of these substances on the caterpillar's feeding. The caterpillars feed only on leaf abaxial surface (lower density of glandular trichomes) during first three instars, and in the other stages they consume the leaves totally. The bioassays showed that the larvae avoid these lactones only in the first stages of the development. Besides, the period of occurrence of these caterpillars coincided with the lowest production of sesquiterpene lactones by plant, mainly of the tagitinin C. There are also some physiological changes (in evaluation) during the third to fourth instar when the rate of consumption of these caterpillars decreased and after this phase the larvae increase the consumption substantially. At the moment, we are investigating the biochemical mechanisms associated with the biology of this caterpillar species.

Conditional outcome in a spider-plant system: mutualistic spiders decrease herbivory in the dry, but not in the wet season

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Up to ten spider species of the genus Peucetia (Oxyopidae) live strictly associated with plants bearing glandular trichomes in the Neotropical, Neartic, Paleartic and Afrotropical regions, and this association likely evolved because insects adhered to these sticky structures can be used as food by the spiders. However, little is known about these spider-plant associations, e.g., whether they are mutualistic. In southeastern Brazil, the species Peucetia flava occurs commonly on Rhyncanthera dichotoma (Melastomataceae), a plant that bears glandular trichomes and inhabits temporary aquatic ecosystems (swamps). In this study we tested if this spider species protects the plant from herbivores and if this benefit is temporally conditional. We conducted two experiments, one in the rainy season (December to February) and the other in the end of the rainy season (April), with plants randomly selected to receive two treatments: presence or absence of spiders. In the rainy season the plants are under strong vegetative growth, but at the end of this season they stop to produce leaves and their shoot apexes differentiate to reproductive branches. In the wet season the spiders did not affect leaf herbivory (% of leaf area removed). In contrast, in the end of the wet season Peucetia decreased herbivory in 74% (P = 0.001). This conditional outcome likely occurred because in the wet season the increment in vegetative biomass exceeds the capacity of consumption by herbivores, suggesting that bottom-up forces may have hidden the top-down forces in this system. Since there is no leaf production in the end of the wet season, the leaves remain exposed to herbivores and spiders for more time, thus improving the top-down effects of the spiders in the system. This study is one of the few to report conditionality in spider-plant systems.

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How do mutualistic ant-plant networks change after nine years in a seasonal coastal environment?

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A characteristic of mutualistic networks is that they are highly nested: many generalist species interact with each other, and specialist species interact only with generalists. Pollination and seed dispersal are commonly studied mutualistic networks, while ant-plant mutualistic networks have only been recently addressed. Non-simbiotic ant-plant mutualisms are highly generalized and show important time-space variation in species composition and outcomes. However, no analysis has considered this variation in the topology, structure and nestedness of the resulting network. Here we searched for changes in these attributes in two extrafloral nectary-mediated ant-plant networks, one recorded nine years after the other at La Mancha, Veracruz, a successional coastal environment with seasonal events. Networks were analyzed to test for dissimilarities among species within groups, nestedness, species contribution and ordination. Network ƒ?oAƒ?? had 50 plant species and 23 ant species in 159 associations; network ƒ?oBƒ?? had 42 plant species and 32 ant species in 231 associations. Networks share 19 plant and 17 ant species. Mean species distance was 1.1962 in network ƒ?oAƒ?? and 1.1043 in network ƒ?oBƒ?? for plants, and 0.5958 for network ƒ?oAƒ?? and 0.9726 for network ƒ?oBƒ?? for ants, suggesting higher niche overlap for ants in network ƒ?oAƒ??. Multidimensional scaling showed that for both networks, the most distant ant species were the ones that use more plants as food resources (2 ant species for network ƒ?oAƒ?? and 5 for network ƒ?oBƒ??). Nestedness was 0.9989 for network ƒ?oAƒ?? and 0.9991 for network ƒ?oBƒ??, both highly significant nested topologies (P< 0.001, perfect nestedness =1). More plant species contribute to nestedness in network ƒ?oAƒ?? as compared to ƒ?oBƒ?? (11 vs. 16 idiosyncratic species). Overall, network nestedness is maintained after 9 years, with species diversifying their association patterns, suggesting that seasonality and more stabilized conditions (late in succession) favors niche diversification and richness of mutualistic interactions.

Parasitoids of lepidopteran larvae in the brazilian cerrado: Variation among host plants

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The present study presents an overview of parasitism of caterpillars found on plant species in the Cerrado. Externally leaf feeding caterpillars were collected between 1991 and 2004 on 65 plant species that were visited for at least one year. These data were used to test the relationship between the proportion of parasitoids associated with different species of host plants and 1) dietary amplitude of the Lepidoptera and 2) the proportion of microlepidoptera. A total of 4509 adults emerged in the laboratory along with 1090 parasitoids. The majority of Lepidoptera in the Cerrado are microlepidoptera, especially Elachistidae, Pyralidae and Gelechiidae and the principal macrolepidoptera families are Arctiidae, Geometridae and Saturniidae. Monthly occurrence of Lepidoptera was calculated using monthly totals (14 years)

divided by the total number of Lepidoptera. For parasitoids we used the monthly totals divided by the total number of records (Lepidoptera + parasitoids). Parasitoids accounted for 19.5% of all records, with a high predominance of Hymenoptera (75%). The highest proportion of larvae occurred at the start of the dry season (May to June) while for parasitoids the highest proportion was at the start of the rainy season (September to October). Parasitism varied between 7% and 33% in larvae found on 20 different genera of plants and in 16 of these Hymenoptera were the dominant parasitoids. The variation among plants was not related to the proportion of polyphagous caterpillars (F1, 18 = 1.214; p = 0.285) but did have a significant relation with the proportion of microlepidoptera (F = 6.799; p = 0,017; Rý = 23,4%; Y (arcsen % microlepidoptera) = 0.637 + -0.198 X. Our results indicate that caterpillars suffer differential parasitism based on the host plant and for plants with a higher percentage of microlepidoptera the parasitism is lower.

Layers of interaction in the ant-plant Cordia alliodora
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The ant tree Cordia alliodora, which is found throughout the neotropics, supports different ant species at different parts of its distribution. Resident ants tend scales and mealy bugs that attach to the inside walls of the swollen domatia. Previous studies have shown that the common ant inhabitants of the genus Azteca spp. provide C. alliodora with some protection against herbivores, but the extent of this protection and how it varies among the various associated ant genera at different parts of the tree*ƒ*?Ts distribution remain mostly unknown. Furthermore, very few studies have investigated the role of hemipteran populations in mediating mutualistic interactions between ants and plants. By addressing these questions, we will gain insight into the effects of hosting different insects on the tree, and thereby into how mutualistic interactions can be maintained or broken down.

Inverted phenology in Jacquinia nervosa: A proximal mechanism to escape herbivory in a seasonally dry tropical forest?
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Herbivory in tropical plants has selected for a variety of anti-herbivore responses, including physical and chemical resistance or tolerance. Another potentially important anti-herbivory mechanism is phenological escape, the phenologically-determined availability of plants or plant parts when herbivores are not present or abundant. This mechanism may be operational in seasonal environments, where herbivore abundance is driven by climatic seasonality, if plants are capable of displacing their availability from the time at which herbivores are most abundant. In Mesoamerican tropical dry forests Jacquinia nervosa displays an extreme inverted leaf phenology: foliage is produced during the dry season, and plants are deciduous during the rainy season. We asked if, regardless the evolutionary driver responsible for this phenology, the inverted phenology of this plant led to an escape of herbivory by leafing at a time when most of the herbivores are not present. We hypothesized that if escape works: i) levels of herbivory should be low and, ii) investment in chemical defenses should be low. We also evaluated the significance of escape, if any, via a defoliation experiment. We found that rates of

herbivory were extremely low, below that known for most tropical dry forest plants; standing levels of herbivory were ca. 7-times lower than the average of normal-phenology species, measured the same year, at the same study site. Accordingly, the foliage of J. nervosa contained significantly lower concentrations of total phenols compared to the average of species with normal phenology. Furthermore, the defoliation experiment shows a trend of lower growth in plants of the high defoliation treatment, as compared to control plants. This work shows that tropical plant species may escape naturally to the attack of herbivores through an inverted phenology and that such escape may be of significance for plant performance.

Galling species richness and age in reforested areas of Amazonian rain forest
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The composition of plant species changes during succession and results in community replacement with time. Studies have shown that, during succession, plant species achieve higher richness at intermediary stages, generating a quadratic response pattern. Variations in plant species composition and structure strongly influence the organisms of the upper trophic levels and we suggest that the richness of insect herbivores should parallel that of the plant community. We tested the hypothesis that the high specialized guild of gall- inducing insects should exhibit a quadratic response to forest age in a 25 year old reforestation program of the MineraCao Rio do Norte SA in the Flona Saraca-Taquera in Para, Brazil. Gall sampling was performed during 40 consecutive days in both dry and rainy periods of 2002 on 35 reforested areas with native Amazonian species that varied from 1 to 20 years old. We used gall morphotype as an indicator of galling species richness, and the relationship between species richness and forest age was tested using f?~lm$f$?T linear models. The variation in the richness of galling species correlated linearly and positively with forest fragment age. Furthermore, when a quadratic model was adjusted, a peak in galling species richness was observed at intermediate ages of the forests. In both analyses, the distribution of the residuals achieved normality and the quadratic model provided the best fit of the relationship between galling species richness and forest fragment age. These results corroborated the hypothesis of high richness of galling insects on reforested areas of intermediate age, as at these areas plant species richness may reach higher diversity. The higher richness of plants in restored areas of intermediary ages may be the result of the presence of pioneer and late species as well as some shrubs not normally found in mature primary forests.

Effect of defoliation in sexual expression and its impact on the pollination dynamics of Cnidoscolus aconitifolius (Euphorbiaceae)
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Herbivores and pollinators have great effects on plant fitness. Although there is much knowledge about their individual effects, few studies have been made on the indirect interactions that can be established between this groups and their impact in the ecology and evolution of plants. In the context of the interaction herbivore-plant-pollinator, sexual expression could be a key trait in monoecious species. A change in the type of flowers can influence the

pollination dynamics by changes in pollinator preference or efficiency. This study is an experimental evaluation of defoliation and local-effect on male-female expression of the monoecius shrub Cnidoscolus aconitifolius and its impact on floral visitors. The study addresses the following questions: (1) Does defoliation affects sexual expression in C. aconitifolius? (2) Are these effects equal in three different populations? (3) Does change in sexual expression affect the pollinators dynamic?
The study was carried out in three different environments: prairie of grass, dry forest and moist forest. We observed that defoliation reduced the number of male flowers, but it does not affect the number of female flowers. No differences between populations were found in the proportion of female flowers, but there were differences between the different levels of damage (control, 50% and 100% of artificial defoliation). Although the visit rate of pollinators varied among populations they were not affected by defoliation treatments. This results show that defoliation in C. aconitifolius affect the sexual expression reducing the number of male flowers. As a result, the proportion of female flowers keeps constant despite of its high cost in resources. This suggests a strategy to compensate the effects of foliar damage having as a fundamental objective to maintain the reproductive efficiency. The effects depend strongly on the environmental conditions, suggesting that the interactions with herbivores and pollinators could change according to their geographic distribution.

Larval ecology of the tropical processionary weevil, phelipera distigma (boheman)(coleoptera: curculionidae)

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Phelipera distigma (Boheman) is a tropical weevil that displays a suite of behavioral traits that are unique in Coleoptera. The larvae feed on the leaves of Guazuma ulmifolia (Sterculiaceae) trees; when moving from one branch to another larvae advance forming head to tail processions, using tactile and chemical stimuli to maintain group cohesion. The chemical signal is provided by a communication pheromone that is secreted in the ventral surface of the abdominal segments. The pheromone is short lived and provides larvae a trail to find other individuals throughout the host plant. Larvae also gather in cycloalexic formations, where insects maintain close lateral contact in heads-out-tails-in rings of individuals, presumably for defense against predators and for thermoregulation purposes. This study examined the adaptive significance of group living. We asked whether larval feeding behavior differed among individuals in groups of different size. Also, we asked whether larval group size affected larval survival and examined larval predation when cycloalexic formations were under attack by predatory ants. Larval feeding behavior differed among larvae feeding in groups of various sizes. Larvae in large groups fed more frequently than single larvae or in small groups. In addition, larval groups spent more time on leaf surfaces than isolated individuals. Larval survival was affected by group size. In a field trial, groups of 3 and 10 insects were exposed to predations in experimental branches of the host. After 72 hours, 67% of the larvae disappeared in groups of 3 larvae, in contrast only 22.8% of the larvae disappeared in groups of 10 larvae. Cycloalexic formations were an effective deterrent against ant attacks; in 30 events of ant aggression on the larvae, zero P. distigma larvae were killed. Larvae in cycloalexic formation had their lateral flanks protected, regurgitated gut fluids and bit the ants

when they attacked a group.

Effects of fragment size on plant-herbivore interactions in the Brazilian Atlantic Forest
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The disruption of ecological interactions due to habitat fragmentation is one of the main threats to biodiversity in tropical forests. In this study, we evaluated the effects of patch size on the standing levels of leaf damage caused by insects on the seedling community present in Atlantic Forest fragments, south-eastern Brazil. We compared the levels of herbivory among two small fragments (19 and 57 ha) and one large one (3500 ha). Small fragments like ones of this study represent the predominant forest remnants and the large one represents the few remaining, relatively extensive tracts. Twenty 10-m2 transects were set randomly in each remnant. In each transect, we sampled 10 seedlings at one meter spacing, totalling 200 seedlings in each fragment. The level of herbivory per plant and species was estimated using a weighted average of leaf damage visual categories. For seedlings with more than five leaves, we chose the leaves to be sampled randomly. An analysis of the entire plant community showed that levels of herbivory were significantly reduced in the small fragments (p=0.05). These results are in contrast with those found in studies carried out in some temperate and tropical forests, but are consistent with those found in other neotropical sites. The study raises the question of whether changes in herbivory with fragmentation are idiosyncratic or whether there are some tractable underlying reasons for the contrasting results observed so far. We discuss how we can move forward in solving these seemingly erratic results.
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Herbivory, ontogeny and ant colonization in Cordia alliodora.
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Mutualistic associations are commonly formed between plants and ants, where ants give protection against natural enemies and they received nest sites and in some cases food resources for ant colonies. Cordia alliodora is a tropical tree with an association with the ant Azteca longiceps. The aim of this study is to evaluate the effect of the incidence of ants on the folivory C. alliodora under different ontogenetic phases. Thirty five individuals of different ontogenetic states were selected. We counted the number of damaged leaves by herbivory and the leaf area removed by folivores. We found that all individuals with less than eighty centimeters of height were not colonized by ants in spite of providing domacia at this stage. There were differences in levels of herbivory according to the ontogenetic stage (F=3.5, gl= 536, P= 0.03). Young trees were consumed more than adults. The frequency of damaged leaves with herbivory also vary according to their ontogeny (F= 7.14, gl=30, P=0.0031). The

frequency of damaged leaves of adult trees was greater than young ones. We conclude that the colonization by the ants in Cordia alliodora occurs in plants with more than eighty centimeters in height but not in seedling or saplings of less height and that the youngest plants are more susceptible to the herbivore attack.

Herbivory patterns in deciduous and riparian habitats: Effects of the folivory on the incidence of pathogens and foliar morphology in two tropical dry plant species

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Phenotypic plasticity (PP) in response to the environmental heterogeneity is an important mechanism that affects the adaptation process of the organisms. Examples of PP in plants associated with biotic factors such as herbivory or with abiotic factor are scarce. The folivorous insects affect directly the plant growth and reproductive success, and indirectly the incidence of pathogens. The folivorous insects represent a strong selective pressure on host plants that may affects the morphology design of the leaves. Little information exists regarding of how the morphology of leaves changes by events of herbivory and/or environmental factors. In this study, we evaluated the relationship between leaf morphology, the levels of folivory and the incidence of pathogens in two plant species that occur in both deciduous and riparian habitats at Chamela-Cuixmala tropical dry forest. Plants occurring in these habitats differ in their phenology and moisture availability. Deciduous habitats are seasonal and xeric, while riparian habitats are aseasonal and mesic. The herbivory by folivorous insects was significantly greater in deciduous than in riparian habitats in both plants species. We did not found significant differences in the levels of herbivory among different strata of the canopy for the two species and habitats. Morphometric analyses indicated that deciduous leaves were longer and narrow. In contrast, riparian leaves were wide and shorts. The foliar area was significantly greater in riparian habitats in both plant species and positively correlated with the foliar area consumed by folivorous in both habitats. The frequency of virus was greater in leaves with damage by folivorous than in leaves without damage for the two species in both habitats.

Gender effects of the tree Spondias purpurea on the survivorship of the larvae of the insect borer Oncideres albomarginata chamela (Coleoptera: Cerambycidae)

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Differential investment of resources in reproduction and defense or growth between male and female plants might influence the quality of insect herbivore hosts. Some studies that have evaluated nutritional quality of host plants in dioecious species and their effects on insect herbivores have found no difference in insect survival, larval weight and fecundity between plant genders, while others have shown higher larval survival on female plants under natural conditions or have reported higher fecundity when female insects feed on leaves of male plants. We evaluated the relationship between the nutritional quality of the dioecious tree, Spondias purpurea, and the performance of the larvae of the insect borer Oncideres albomarginata chamela. Nutrient composition between plant genders was determined from a sample of potential branches for removal from male and female trees of Spondias purpurea. Insect performance of the xylophagous species O. a. chamela was evaluated on the larvae developed in the removed branches of S. purpurea. Nitrogen content was greater in female trees but phosphorus content and total non-structural carbohydrates were similar between plant genders. We found no differences in the survivorship of larvae between plant genders. Our prediction that greater larval performance occur on female branches because of greater nitrogen content was not supported by our results. Other factors associated to the variation in plant resistance or competition should be analyzed to account for larval performance of O. a. chamela and to explain why this cerambicyd seems to selects female over male individuals S. purpurea.

Why are fruits colorful? The relative importance of achromatic and chromatic contrasts for detection by birds

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The colors of fruits and flowers are traditionally viewed as an adaptation to increase the detectability of plant organs to animal vectors. The detectability of visual signals increases with increasing contrasts between target and background. Contrasts consist of a chromatic aspect (color) and an achromatic aspect (light intensity), which are perceived separately by animals. To evaluate the relative importance of fruitsƒ?T chromatic and achromatic contrasts for the detection by avian fruit consumers we conducted an experiment with artificial fruits of four different colors in a tropical forest. We displayed the fruits against two different backgrounds, an artificial background and a natural one, because they differed in achromatic properties. We found no effect of the type of background on fruit detection rates. Detection rates differed for the four fruit colors. The probability of detection was explained by the chromatic contrast between fruits and their background, not by the achromatic contrasts. We suggest that birds attend primarily to chromatic contrast probably because these are more reliably detected under variable light conditions. Consistent with this hypothesis, we found habitat-specific differences in the conspicuousness of natural fruit colors in the study area. Fruits of understory species that are subjected to the variable light conditions within a forest displayed higher chromatic contrasts than species growing in the open restinga forest with constant bright illumination. There was no such difference for achromatic contrasts. In sum, we suggest that fruit colors differ between habitats because fruit colors that have strong chromatic contrasts against background can increase plantsƒ?T reproductive success, particularly under variable light conditions.

The impact of antagonisms: effects of assimetric morph florivory on the floral chemical defense of distylous shrub Palicourea padifolia

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Multiple interactions such as mutualisms and antagonisms exert complex selective pressures that could determine individual plant fitness. Floral herbivores can negatively affect plant reproductive success, both directly and indirectly. Distylous plants, in which morphs not only differ in the reciprocal position of the anthers and stigma but also in the quality and quantity of floral displays, chemical defenses, and pollinator rewards, typically present an unequal floral morph attractiveness for mutualist (i.e. pollinators) and antagonist (i.e. herbivorous and florivorous). Then, distylous plants as Palicourea padifolia, offer the excellent and nearly untested opportunity to study the effect that variation on floral morph chemical defenses have on the attractiveness to their widespread floral antagonist, the Drosophilid flies Zygothrica sp. Our results suggest that the differential attack rates of the florivorous fly Zygothrica sp. and their asymmetric impact on floral morph fitness are related with a differential allocation of floral chemical defenses between floral morphs of P. padifolia.

Experimental evaluation of the effects of two insects on growth and survival of the invasive tree Melaleuca quinquenervia in Florida

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We investigated the effects of two insect herbivores introduced as biological controls, on growth and survival of seedlings of the invasive tree Melaleuca quinquenervia (Myrtaceae). The two insects are the leaf-feeding weevil Oxyops vitiosa, and the sap-sucking psyllid Boreioglycaspis melaleucae. We experimentally exposed M. quinquenervia seedlings to different densities of weevils and/or psyllids in a greenhouse. M. quinquenervia occurs in two contrasting soil types in Florida, organic and sand, and this was incorporated into the experiment. Each seedling was transplanted to an individual pot and placed inside a screened PVC cage; one replicate consisted of three potted seedlings within a cage. Insects were manually added to each plant twice throughout the duration of the experiment. The experimental design consisted of two levels of weevil densities (low/high), two levels of psyllid densities (low/high), and two soil types (organic/sandy) combined in a 2x2x2 factorial design, along with caged and uncaged controls (5 replications each, N=100). We estimated growth as relative change in height, stem diameter and number of leaves, and we recorded survival. We found an independent negative effect of high density of weevils and psyllids on seedling height compared to control plants. When both insects were present in high densities, the effects on seedling height were intensified. Caged controls, and low and high psyllid density plants grew relatively more in organic than in sandy soil. No differences between soil type were found in the rest of the treatments. The presence of both insects at high densities decreased survival of plants growing in organic and sandy soils

compared with controls and plants receiving damage from only one type of insect. Our experiment shows that both weevils and psyllids are effective in reducing M. quinquenervia seedling growth and survival, and that the effectiveness is stronger when both insects are present in high densities.

Biodiversity inventories & conservation

TUESDAY JULY 17

Community structure of dung beetles (Coleoptera: Scarabaeidae) in different land use systems of the Brazilian Amazon
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The role of biodiversity in tropical agricultural systems is still poorly understood. However, such understanding is fundamental for the development of sustainable strategies for agroecosystem management, particularly when the environmental impact of different land use schemes is to be assessed. The present study aimed to verify the impacts of six distinct land use systems on dung beetle communities (Scarabaeidae) in the upper Solimoes river (State of Amazonas, Brazil). The Scarabeidae were selected as bioindicators because they respond negatively to anthropogenic environmental change. The hypothesis that dung beetle community is negatively affected by changes in structural complexity of the vegetation was tested by measuring and comparing beetle diversity and community structure across six land use systems in three survey areas. Beetles were sampled by means of pitfall traps baited with human faeces. A total number of 3048 individuals, belonging to six tribes, 15 genera and 51 species, were collected. Results show that land use systems with greater vegetation complexity are associated with increased community diversity

Integrated Conservation and Development Projects (ICDPs): A New View for the Future of Biodiversity Projects
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Conservation biologists have been trying to design *f*?owin-win*f*?? situations where the conservation of biodiversity and the socio-economic development of local people are met and enhanced through each other. In order to meet both conservation and socio-economic objectives ICDPs have been implemented in protected areas that are based on a zoning system (core area and multiple-use area). Although ICDPs were originally designed to fuse conservation and development, the experiences learned today have shown us that it is a harder task than imagined and that ICDPs need to be examined once again. We understand that the mitigating factor determining the success or failure of ICDPs seems to be the underlying assumption that conservation and poverty are affected by the same policy. We propose a policy change in which two separate agendas are needed for the success of ICDPs. One agenda would priorities conservation, Conservation Projects with Development (CPD) and another would priorities development, Development Projects with Conservation (DPC). CPD should be implemented when core areas represent an economic incentive for local communities and DPC should be implemented when local communities living outside protected

area boundaries have a negative impact on biodiversity conservation. CPD will focus their management agenda in strict protection of the core area through law enforcement, education and natural resource management. On the other hand, DPC will focus their management agenda in the application of eco-technology activities. Our goal is to offer an alternative way to consider ICDPs. ICDPs will not be viewed as a biodiversity project but as a project that has two distinct and separate policy agendas. Conservation agenda and Development agenda will lend support to each other but will not fuse their main goals. We understand that the success of ICDPs will depend primarily on maintaining separate policy agendas for the conservation goals and the development goals.

Identifying priority areas for conservation in mexican tropical deciduous forest based on tree species

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The main objective was to identify and rank areas for the conservation of exclusive or nearly exclusive tree species of the tropical deciduous forest (TDF) in Mexico, a land cover type greatly endangered worldwide. A list of 425 species of trees (67.5% endemic to Mexico) including in 56 families and 185 genera registered at the level of state was compiled from an exhaustive revision of the specialized floristic literature. The conservation status of these species was assessed by registering their presence in the areas of TDF located within the limits of Mexican natural protected areas. A parsimony analysis of endemicity (PAE) led to identify 16 areas of endemism, supported by 54 synapomorphies and 73 autapomorphies (72.4% endemic to Mexico). Protected areas include a low proportion both of the total tree species (129 species, 30.3%) and of the 127 species characterizing areas of endemism (56 species, 44.1%). In the latter group, only 7 are included within a category of risk. Analyses of complementarity (total richness of species and of species within areas of endemism) and of phylogenetic diversity (families and genera) are coincident in assigning high priority for conservation to areas in the states of Chiapas, Guerrero, Jalisco, Michoacan, Oaxaca, and Yucatan. Based on the results, specific recommendationsare provided for the design of strategies for the conservation of the trees of the Mexican tropical deciduous forest.

Research at the Osa Biodiversity Center, Osa Peninsula, Costa Rica

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In January, 2007, Friends of the Osa opened a new facility for the study of tropical biology and conservation. The Osa region, which contains the most extensive remaining Pacific wet forest and the largest Pacific coast mangrove forest in Mesoamerica, is a premier location for increasing the capacity for research, conservation and education. The adjacent Golfo Dulce is one of only four tropical fjords, and is a site where large numbers of whale sharks aggregate, and northern and southern populations of humpback whales come to raise their calves. The Osa region, furthermore, contains the highest tree diversity and the largest population of scarlet macaws in Central America, and Corcovado National Park supports huge numbers of white-lipped peccaries and other large mammals.

Friends of the Osa supports several research and conservation projects in the region. Three

species of endangered sea turtles nest along the Osaƒ?Ts beaches. Last season we recorded almost 4,000 nesting visits and protected and released over 6,500 hatchlings. We are currently conducting a camera trapping study (100 cameras) to understand the distribution of large cats and their prey across the landscape. We are using this information to establish strategic wildlife corridors adjacent to protected areas that maximize landscape connectivity and species persistence. We are examining the distribution and ecological requirements of three endangered, endemic bird species. We are focusing on the yellow-billed cotinga (Carpodectes antoniae), a virtually unknown species that may be in critical danger of extinction. Its largest known nesting population appears to be restricted to a small, threatened mangrove forest. Results from several other projects will also be discussed.

Opportunities for Biodiversity Conservation in Northern Peru

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Plans for oil exploration and development are advancing in Northern Eastern Peru, an area of high biodiversity importance by most national and international conservation organizations. The Smithsonian Institution Monitoring and Assessment of Biodiversity Program (MAB) has been working for several years with oil and gas companies to integrate biodiversity conservation into operations, increase biodiversity knowledge, build local capacity through technical training, and to spread information generated to wide audiences. MAB is working with the Peruvian government, local conservation organizations and three oil companies to create a regional conservation and development plan that is expected to reduce to a minimum the impact of the potential oil production and to assure the long term conservation of the area.

Conservation of vascular epiphyte diversity in secondary forests and citrus plantations in Los Tuxtlas, Veracruz, Mexico

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We studied the species richness and floristic composition of vascular epiphytes in three vegetation types along a gradient of anthropogenic disturbance in close vicinity to the Biological Research Station "Los Tuxtlas" in southeastern Veracruz, Mexico. Epiphyte diversity was compared in 21 plots of 20 x 20 m each, in tropical rain forest (6 plots), secondary forest (7) of 20 years and citrus plantations (8) of 30-40 years, in order to determine if both disturbed habitats can support to the conservation of these plants. We recorded a total of 81 species of vascular epiphytes in14 families and 49 genera. 58 species were found in the tropical rain forest, 42 in secondary forest, and 51 in citrus plantations. Orchidaceae was the richest family in epiphyte species, followed by Pteridophytes (ferns), Araceae, Bromeliaceae, and Piperaceae. Orchid species were the most affected by the anthropogenic disturbance showing a decrease of 68% in secondary forest and of 19% in citrus plantations, in comparison with the adjacent tropical rain forest. In contrary, species richness of aroids and ferns was similar for all three vegetation types. The diversity of epiphytes was correlated with the age of host trees and the distance of the disturbed vegetation from the natural forest. The study shows that secondary forest and citrus plantations can support to the conservation of vascular epiphyte

diversity, however, not all taxa can colonize both types of disturbed vegetation. Especially, many species of orchids would disappear by a complete transformation of the tropical rain forest, because these seem to have special requirements concerning water availability and humid microclimatic conditions. Furthermore, these epiphytes show a preference for horizontal branches of old trees covered by thick layers of bryophytes, which provide a suitable substrate for their germination and establishment.

Susceptible areas of vegetation in Mexico before the climatic change
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We analyzed areas of vegetation in Mexico will be affected before the changes that will take place in the climate according to global models. These models evaluate the modifications in temperature and precipitation for years 2020 and 2050. The answers of associated global models of climatic change and emissions scenarios are used like: GFDL-A2, GFDL-B2, Hadley-A2 and Hadley-B2 and are applied on a constructed climatic base with 1961-1990 data. It is evaluated as they are the affected vegetal communities, based on the actual distribution and present conservation state (2002). For the 2050 one hopes that at least half of the vegetal cover faces changes in the climatic conditions in which they settle down at the moment, great part of the desert scrubs and the grasses will be exposed to greater drought. Temperate forests will be exposed undergo greater stress by the increase in the temperature. Thorny and tropical deciduous forest also will be affected. Sensitivity to the climatic change is increased by the conservation state that the vegetation presents at the moment, as well as it deforestation rates of and the level of alteration that reign at national level. Before these scenarios it is necessary to raise measures to mitigate the change

Mexicanâ?Ts mangroves: Current state and the establishment of a long-term monitoring program
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Mangroves are strongly reduced worldwide and the annual global loss is estimated to be approximately 2%. In Mexico the situation is not different from the worldwide status of mangroves and there have been various attempts to estimate the coverage of this vegetation type. Without doubts there exist large discrepancies between the estimations which makes it complicate to determine a reliable deforestation rate of mangroves on a national level. Within this frame the present study has as objectives i) to obtain information about the presence and distribution of mangrove forests in Mexico, ii) to implement a long-term monitoring program using remote sensing and in-situ data and iii) to build up a Geographical Information System of

mangrove forests for Mexico.
To evaluate the distribution and extension of mangroves more than 100 satellite images (SPOT) were classified. By the end of the first year of the project (2007) about 90% of the potential national mangrove cover has been determined. The validation of the results is currently being undertaken through field data and through cooperations with regional institutions.
As a first step towards the establishment of the long-term monitoring program forming a ƒ?oMonitoring network of Mexican mangrovesƒ?? an online expert database on Mexican mangrove forest has been set up.
Through the integration of existing data and new information about Mexican mangrove forests in a Geographical Information System (GIS) a new decision support tool will be created in future to assist the conservation, management and reforestation strategies of Mexican mangrove forests.
During the next stages of the project the changes in distribution and extension of the mangroves over the last decades will be estimated and the principal human impacts will be identified. Further, the main fragmentation processes will be described and potential sites with major suitability for the mentioned conservation and rehabilitation measures will be delineated.

A Manual of Field Methods for the Rapid Assessment of Terrestrial Biodiversity
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The Rapid Assessment Program (RAP) at Conservation International, in collaboration with a expert scientists from a wide range of institutions, has developed a manual ƒ?oField Methods for the Rapid Assessment of Terrestrial Biodiversity." The objective of this manual is to provide details of field methods for use by scientists and students interested in the rapid inventory of terrestrial biodiversity. The objective is not to cover all possible methods, but to present two-three methods most used by expert biologists to do a rapid biodiversity survey. The manual also includes a general overview of rapid assessment approaches taken by several institutions, highlighting the benefits and limitations of each approach. Specific field methods and data analyses are included for rapidly surveying plants, dung beetles, katydids, ants, termites, terrestrial mollusks, butterflies, dragonflies, amphibians, reptiles, birds, small mammals, and large mammals, with special sections on bats and primates. Additional sections are presented on communicating the results of a survey to a wide variety of audiences (scientific, government, general public) and on integrating survey data into conservation decision making. A draft of the manual and several of the contributors will be available at the poster presentation. This manual is being used as the basis for a biodiversity assessment curriculum, currently in development.

Interaction of spatial arrangement with killing agent on cricket (Orthoptera: Grylloidea) sampling efficiency
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Previous work suggested that use of more efficient killing solution would reduce cricket escape, enhancing sampling efficiency. In this work, we aimed at testing this, comparing shallow (10cm) with deep (20cm) traps, combined in two spatial arrangements (along a transect or in the angles of a square) and three killing solutions (alcoholic; chloral hydrate; or saline). We settled an incomplete factorial design, with three replicates of all factor combinations, but the combination of deep traps with chloral hydrate. Each replicate corresponded to one of three sites, within the same forest. Traps were settled in four traps*ƒ*?T clusters. There were 120 traps, kept in field for 48 hours. We captured 317 individuals from 8 species, in 6 genera: Phoremia, Ectecous, Eidmanacris, Izecksohniella, Laranda and an unidentified genus of Luzarini. We carried out 2 analyses: (a) without deep traps and (b) without chloral hydrate traps. In both, we adjusted (i) mixed effects models (site as random effect, n=96) and (ii) generalized liner models with Poisson errors (each cluster within site as replicate, n=24). There was interaction of killing solution with trap arrangement: while alcoholic captured more species in any arrangement, chloral hydrate captures were affected by arrangement: while traps in squares didn*ƒ*?Tt differ from salt, those in transects were equal to alcohol ($p<0.001$). Trap deepness didn*ƒ*?Tt affect captures ($p=0.08$). Besides killing more rapidly than salt, alcohol possibly attracts frugivores, irrespective of arrangement. Chloral hydrate doesn*ƒ*?Tt exhale odour, therefore it acts at very local spatial scale. This may explain detection of trap arrangement effects in this solution: transects intercept larger area than square, probably intercepting more species with aggregated and alotopic spatial distribution. Concluding: (i) increasing depth doesn*ƒ*?Tt enhance efficiency, (ii) the most efficient killing agent is alcoholic, and (iii) to detect effects of local spatial distribution, one must use chloral hydrate.

Assessing Regional Land Cover Change in the Lerma-Chapala-Santiago Watershed through the
Use of Satellite Imagery

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The ability to monitor land change through the use of remotely-sensed satellite imagery has provided researchers with many metrics of identifying changes in vegetation across broad areas of the Earth*ƒ*?Ts surface. These changes in land cover can indicate patterns of modified land use or associated environmental degradation, but to ascribe these changes to anthropogenic influences or independent natural variation has proven to be a very complex endeavor, especially in diverse and rapidly-changing regions, such as the Lerma-Chapala-Santiago watershed of Central Mexico. Previous research has been facilitated by the use of Landsat-like imagery, with 15-30 meter pixels that provide a convenient analogue to anthropogenic and natural features in the physical landscape, but these data are problematic for studies of seasonal variability due to the large time gap between usable images. The increased frequency and broader swath of coarse-resolution imagery offers the opportunity to examine the interannual and interseasonal trends between and surrounding two discrete image dates, but lack the spatial detail of higher-resolution products. Using a combination of 1-kilometer-resolution classified land-cover products and multispectral imagery from the MODIS program, this poster-paper illustrates the distinct patterns in the quantity and location of change across the Rio Lerma-Chapala-Santiago watershed of Central Mexico.

Automated remote data collection as a new tool to monitor tropical biodiversity

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Our present understanding of biological systems is inadequate because our knowledge is based on a very limited spatial and temporal coverage. Given the cost of having experts in the field, data collection is concentrated in a few sites (e.g. research stations), and this highly aggregated distribution of information limits our ability to understand large-scale ecological processes and to properly manage large areas. From both a conceptual and management perspective there is an urgent challenge to increase biological data collection over large areas. Here we present a protocol and preliminary data on an Automated Remote Biodiversity Monitoring Network (ARBIMON). We will test ARBIMON in 16 sites located at high elevation (>800 m) in the island of Puerto Rico. In each site a monitoring station composed of an omni directional microphone and transmitter will collect long term acoustic data of birds and amphibians continuously for 24 hours. The sound data is sent to a by a wireless transmitter to a data analysis node were mini computers will automatically identified species using machine learning algorithms such as artificial neural networks, turbo-code hidden markov models and decision trees. We have already modeled amphibians as a decision tree, in which frequency of call, duration of call and time between calls identifies each species. Given the more complex structure of bird calls, artificial neural networks or turbo-code Hidden Markov Models will be used to automate the species identification process. ARBIMON will be useful to increase the spatial and temporal coverage of data available to study natural fluctuations in bird and amphibian communities.

Image Identification Systems: An Automated Plant Identification Tool for Exploration and Discovery in the 21st Century

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The Image Identification System (IIS) is a tablet PC-based interface for the automated identification of plants in the field. The IIS, now in development, requires a library of plant digital images coupled with an effective retrieval system and mobile computing mechanism for accessing information contained in the digital image library. In the field, an image of a leaf of an unknown species is captured with a digital camera and wirelessly transferred to the tablet PC. IIS then searches the entire database of plant images for visual similarity using biometric computer vision algorithms. When the search is completed, usually in a matter of seconds, the results are displayed in a ranked order of probable identification and viewed on a zoomable canvas format. Ancillary information to aid in confirmation of the identification, such as herbarium voucher images and color field images of living specimens, are also included. Initial field tests of 250 species found on Plummers Island in the Potomac River (ten miles from the US National Capitol) demonstrated an extremely high accuracy of the prototype device. Currently, temperate zone data sets include species of Plummers Island, the woody plants of the Washington-Baltimore metropolitan area, and the trees and shrubs of Central Park in New York City. We have started to address a more challenging domain: the tropical woody flora of Barro Colorado Island, Panama. Tropical plant species, often with extremely similar leaf

shapes, will require a different approach to plant biometrics; systems for automated recognition of leaf venation patterns are now being developed. IIS will eventually be employed as an application on a hand-held device, such as a PDA or mobile phone, and will also be available via the internet to provide immediate identification of specimens at home or in the field.

Multiple analyses of environmental and structural variables to characterization of Quercus and Pinus forests in the La Primavera, Jalisco, Mexico

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Mediante un analisis multiple de variables ambientales y parametros dasometricos se comparo la estructura de comunidades arboreas de Quercus-Pinus por tipo de densidad de cobertura y uso de suelo en la microcuenca del rio salado del area protegida Bosque La Primavera, como una descripcion asociada para la gestion de servicios ambientales hidrologicos. Se establecieron sitios circulares de muestreo donde se registraron variables ecologicas y datos del arbolado adulto mayor a 7 cm de diametro. La microcuenca cubre una superficie de 123.8 km2, con una longitud de cauce de 26 km y una cobertura forestal de 78% compuesta de Quercus-Pinus. La zonificacion del area incluye un 23% con algun tipo de uso, el resto se consideran zonas restringidas o de total proteccion. Se definieron cuatro tipos de densidad forestal con base a una fotointerpretacion, siendo: bosque menor a 25%, entre 25 y 50%, entre 50 y 75% y mayor a 75% de cobertura. Del analisis de ordenacion polar Bray-Curtis, las relaciones entre la abundancia de las especies, la densidad de cobertura y 20 variables ambientales se distingue que: a) el grado de presencia de pastoreo, rocosidad y pedregosidad explicaron el 60.5% de la variacion entre sitios con coberturas >50% segun sea la dominancia de Quercus resinosa o Q. magnoliifolia; b) el 18.1% de la variacion fue relevante debido a la estructura del bosque manifestada en la abundancia, area basal, relacion altura/diametro y perfil vertical, vinculada al grado de afectacion por incendios, siendo mayor en bosques densos y c) los aspectos del paisaje como pendiente y relieve representaron el 14.1% de la variacion explicada por sitios abruptos en coberturas forestales <50%. La variabilidad estructural de los bosques es alta, no reflejando un patron caracteristico por tipo de densidad, posiblemente relacionado con el historial de manejo y disturbio antropogenico y natural del bosque.

Addressing the causes of rarity of Fouquieria purpusii in the Tehuacan Valley, south central Mexico

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Fouquieria purpusii is an endemic plant species inhabiting the Tehuacan Valley which exhibits all the features of rarity: a limited range of distribution restricted to a specific area of the Valley, and with low density populations showing high habitat specificity. Currently, it has been considered as an endangered species (NOM-ECOL-059-2001; CITES, 2007), but the causes of its rarity are still unknown. The aim of this study was to determine the causes of the abundance and distribution of this plant by means of studying the habitat specificity, the reproductive biology and a demographic analysis of different populations. The causes of the rarity were predicted as a consequence of a high habitat specificity of isolated populations restricted to

sites characterized by a predominance of limestone rocks, and high reproductive limitations given by pollen and seed limitations.
Our results indicate that successful establishment only occurs in calcareous limestone cracks, which maintain higher water potentials during longer periods than soils. The poor pollinator attraction (bees and hummingbirds), inbreeding and outbreeding depression, a low seed set (12 %) and extremely low seedling survivorships (0.018%) are indicative of a decreasing population growth rate in all the studied populations (Finite rate of increase less that 1). These data can be interpreted as evidence that under the prevailing conditions, the permanence of natural populations of F. purpusii is under risk. Moreover, its high habitat specificity and restricted regeneration requirements prevent this plant to colonize new environments and to expand its distributional range, turning the species unviable in genetic terms.

http://www.helechos.com.mx a useful tool for ecologists and biologists
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We present a web page containing comprehensive information dedicated to the Pteridophyta (ferns and allied plants). The site should be very useful to students of all levels, pteridologists, botanists, ecologists, and the general public. The goal is to have the best fern web page in Spanish (although titles will be translated to English) found in the Internet. It will be translated to Portuguese (Brazil). We will present a wide range of information, from generalities like what is a fern, descriptions, families, photos of species, up to sections dealing with the important of ferns in every day life and in ecology. Also, we will present our different collaborative projects, the problems for their conservation, and information on how to take care of ferns at home, their cultivation, their presence in art, magic, photography, poetry, food, games for children, and the absurd. The page contains ca. 600 links, 14 thousand files in 700 folders, more than 13,500 images for a total of more than 4.5 GB. It includes .pdf files which can be downloaded, published papers from the project; it will also be possible to access the reference data base of the project and later on scanned specimens of Mexican (mainly Veracruz, El Bajio region and Yucat n) and Caribbean ferns. It also includes information on the care of trees and on the lack of sensibility when dealing with urban trees and their pruning, which includes many photos and images. The Pteridophyta Projects is housed at the Instituto de Ecolog¡a, A.C. All pages are ready and are slowly being ƒ?~publishedƒ?T.

An illustrated guide to the ferns of Xalapa, Veracruz, Mexico
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We present an advance of the Illustrated Guide to the ferns of Xalapa, Veracruz, which is based on a recent inventory of the ferns in this region. To accomplish this, we reviewed material from several Mexican and ca. 40 foreign herbaria, together with collections accomplished from 1983 onwards. The material and methods used were based on Leenhouts (1968. A guide to the practice of Herbarium Taxonomy and Nomenclature of the International Association for plant taxonomy. Netherlands. 60 pp.). Xalapa is located within the central portion of the state of Veracruz (19ø36' N, 19§29' S, and 96ø48' E, 96§58' W), the dominant vegetation is the montane cloud forest (ƒ?~bosque mes¢filo de monta¤aƒ?T), however, there

are small portions of oak forest and tropical lowland dry forest. We found 26 families, 59 genera and 190 species, the families with the most species, are Pteridaceae and Polypodiaceae (31 sp. each), Thelypteridaceae (17 sp.), Hymenophyllaceae (14 sp.), Aspleniaceae (12 sp.) and Blechnaceae (10 sp.); the rest have less and 10 species. We include dichotomy keys to identify families and genera, current synonymy, taxonomic descriptions, data on their distribution, and conservation status within the state. We also include images of the different species. We hope that the guide will be used in the field by students making it unnecessary to collect in areas that have been heavily collected in the past for teaching purposes. The latter has depleted fern biodiversity in many areas. Finally, with the aid of several undergraduate students, we are also preparing illustrated guides for the state of Veracruz, and in particular for the areas of: Banderilla, Coatepec, San Andr,s Tlalnelhuayocan, Xico, Teocelo, Calcahualco, La Joya, Las Vigas, El Volcancillo, Naolinco, Chiconquiaco, Jilotepec, Los Tuxtlas, and Tlanchinol (Hidalgo) and Cuetzalan (Puebla).

Ecology and conservation of vertebrates

TUESDAY JULY 17

Variation of detection probability of medium and large-size terrestrial mammals using camera traps in the Central Amazon, Brazil
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The cryptic habits and low densities of the most of neotropical mammals make study difficult. The camera trap method has been successful used to estimate population densities for these mammals. Nevertheless, it is necessary to research the environmental factors which influence the detection probability of the animals, as the efficiency of the camera trap is directly related to the appropriateness of its placement. From this view point we determinated the detection probability of the medium and large-size mammals in different environmental conditions and using different sampling schemes. The study was carried out in two terra firme forest areas north of Manaus, Central Amazonian. In each of the study areas Cam Trakker cameras were installed at seven sampling points 1.5 km apart. Data were collected in three different two-month sampling periods (dry and rainy seasons). The efficiency of the camera trap method for detecting animals was estimated using a maximum likelihood analysis. Models incorporated sampling co-variables (season and number of cameras) and sites co-variables (hunting pressure and distance from nearest stream). The detection probability of mammals, for a 15-day period at any one point site, varied between 0.09-0.65. The highest detection probability occurred utilizing two cameras per point, during the rainy season, in an area with less hunting pressure and localized close to a stream. Overall sampling effort during the three study periods was 2320.63 camera-days, with 72 independent mammal records, comprising 17 species. Total capture success was 3.1%. The capture success was relatively low in comparison with other studies likely due to differences in sampling effort, equipment efficiency, environmental variations and human disturbance. We recommend, in order of the importance, the following factors to increase the detection probability: sampling to be done in the rainy season, in low hunting pressure areas and at points localized close to a stream.

Effects of certified forest management on the bird community in a Mexican Pine-Oak forest
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The main objective of this study was to evaluate the effects of forest management on the resident bird community in the certified pine-oak forest of San Juan Nuevo Parngaricutiro, Michoacan, Mexico. Three areas within the forest were chosen. Each area had three adjacent forest patches, each with a different forest management treatment. From higher to lower vegetation-disturbance level treatments were: (1) Old forest, (2) third clearing (an open forest with low density of large trees), and (3) regeneration cut (a very open vegetation with a few sparse seed-trees). Using count-transects and mist-nets a total of 49 resident bird species were recorded. Bird species showed different responses according to the level of habitat disturbance, and according to the area. Overall, bird diversity and equitability decreased as the

level of forest disturbance increased, except in one of the areas, where values were lowest in the old forest. In two areas the regeneration-cut treatment had the lowest species richness, diversity and equitability. Forest areas with the third-clearing treatment had an important role as habitat for a relatively large number of species, although their role in the long-term maintenance of bird populations remains unknown. Also, there were conspicuous differences in the composition of the avian community and in the relative abundance of certain species, among treatments. In general, insectivores decreased, while nectarivores increased their abundance with increasing intensity of forest management. The long-term persistence of a highly diverse avian community in this managed forest depends upon the maintenance of large areas as ƒ?oecological reservesƒ?? that should preferably be interspersed and connected among each other within the mosaic of forest patches with timber extraction. Also important is that the tree diversity within logged forest patches be actively maintained to avoid the slow formation of a pine-monoculture system in the future.

Diet flexibility and diet item treatment in the golden-backed uacari,
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Like other members of the genus, the golden-backed uacari, Cacajao melanocephalus ouakary, has a dentition, skull and cranial musculature that have been widely interpreted as being adapted to a diet of hard-husked fruit. In this study we show that 'hard' is better termed ƒ??resistantƒ??, since many of the major components of the diet are fruit that possess either leathery (Eschweilera: Lecythidaceae) or spongy (Swartzia: Fabaceae) outer coverings, not highly sclerotized ones (though these do also occur, e.g. Corythophora and Licania, both Lecythidaceae). We consider how these items are processed and manipulated while being bitten open, so that the maximum volume of edible material is available for ingestion and the not lost to the floodwaters below. Furthermore, we reveal that, at certain times of the year, uacaris are eating large amounts of non-fruit items, including bromeliad leaf bases and the flowers of Eschweilera tenuifolia. Occurring just before the uacari's igapo habitat begins to flood, a period of fruit dearth, flower choice appears highly selective, with only abundant diurnally insect-pollinated flowers being eaten, while others (such as the bat-pollinated species) are ignored. Nectar and pollen are probably the attractions. These observations parallel those made on Cacajao calvus which endure similar fruit availability pulses, and also previous observations at the start of the dry season, when in another temporary fruit-dearth, this uacari eats leaves.

A Comparison of Bat Activity in Clear-Cuts and Forest Edges in Toledo District, Belize and

Delaware, USA
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We compared bat activity levels (both commuting and foraging calls) between forest clearings at the Belize Foundation for Research and Environmental Education in Belize and in Delaware, USA to assess potential predator avoidance strategies used by bats in different habitats. Bat activity was quantified for 10-minute intervals at the forest edge and in the open habitat for several nights in both habitats. Bat calls were recorded using a Pettersson D240x ultrasonic detector and downloaded onto a laptop loaded with SonoBat analysis software. We also monitored bat passes and feeding buzzes using Microbat (Stag Electronics) ultrasonic detectors, which have a similar detection cone to the Pettersson units. Bat activity in Belize was higher in open areas, which was in contrast to data from Delaware where bat activity was higher near forest edges than open areas. The differences in bat activity levels may be attributed to the types of predators in tropical versus temperate forests and thus demonstrates different predator avoidance strategies utilized by bats. There tend to be more arboreal predators, such as snakes and tree-foraging mesopredators, in tropical rainforests as opposed to more open-area predators, such as owls and foxes, in temperate forests. Insect availability may also influence bat foraging patterns. We discuss the potential interactions of these two factors in determining bat activity.

How to terrestrial mammals effect tropical plant functional diversity?

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Seed predation, herbivory, and seed dispersal are just some of the mechanisms by which terrestrial mammals influence the composition of the plant communities they inhabit. They also indirectly influence levels of competition among plants by lowering plant densities. 13 years ago, long-term exclosures were constructed in the Barro Colorado National Monument in Panama which exclude terrestrial mammals such as agouti, peccaries, and deer. To determine how animal-mediated filters shape the functional trait composition of a tropical forest community, we compared the functional trait compositions of the communities exposed to ambient mammal pressure and the exclosure communities. We evaluated specific leaf area (SLA), leaf toughness, leaf water content, and seed mass. We expected that community mean SLA would be higher inside the exclosures, as higher SLA values are associated with faster growth rates and possibly better competitive ability. We predicted that average leaf toughness would be lower and average seed mass would be higher inside the communities, due to decreased herbivory and seed predation. Water content was expected not to differ. In accordance with our predictions, community mean SLA was higher and leaf toughness lower inside exclosures. However we found no significant difference in seed size. Interestingly, within species, leaf water content was lower inside exclosures for most species, suggesting that competition for water might increase in importance upon exclusion of mammals.

How close is close enough? Forest gaps and movement of tropical forest birds

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Studies on the effects of habitat fragmentation on species distribution suggest that movements of some tropical resident birds, especially understory insectivores, are restricted by open areas in fragmented landscapes. It has been suggested that this restriction arises because forest species perceive the open matrix as inhospitable habitat in which energetic costs and predation risks are higher and, therefore show reluctance to cross it. Reluctance to cross open habitat may be due to behavioral or physiological constraints. For example, perceptual range or the distance from which a given animal can detect a particular landscape characteristic determines the amount of information available for the individual and therefore may exert a great influence in movement decisions. I used a release experiment to investigate the effects of forest gaps of different widths (50, 100 and 150 m) on the movement patterns of birds of the tropical forest. During July and August of 2006 I conducted 139 release trials that included 25 species of forest birds. Gap width had a significant effect on orientation of the first move (chi-square = 59.88, df = 2, $p<0.01$). In release trials from 50 m, 86% of the birds moved directly to the forest. At greater distances, direct orientation of first move decreases (19% and 25 % from 100 m and 150 m). Gap width had a significant effect on the destination of the first move (chi-square= 83.04, df = 4, $p < 0.01$). From 50 m, most individuals (88%) reached the forest in a single move. From 100 m and 150 m, the first move of most individuals (55% and 63% respectively) ended on the ground, in very close proximity (less than 50 m) from the release point. These results suggest that at larger distances, individuals are less able to detect the forest and perform direct movements.

Activity patterns and diet of two howler monkey troops (Alouatta seniculus) in an isolated Andean forest

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The howler monkeys are remarkable in their adaptability to drastic habitat conditions and tolerance to phenological variations, and they perform behavioral and diet strategies that allow them to live in a wide variety of forest types. Nonetheless, the Andean populations remain poorly studied and the knowledge of the ecological strategies of their populations is important, given the high rates of habitat disturbance in mountain forests. The main objective of this study was determine the activity patterns and diet of the two red howler monkeys troops of a subandean forest fragment (ca. 5 km2, 1700 m elevation), in Reserva Natural de Yotoco, Valle, western Andean range, Colombia. Behavioral sampling was conducted between January and June of 2005, using focal animal sampling, and phenological transects were monitored to assess resource availability. Both troops spent most of the time resting (59.3%-60.4%), followed by feeding activities (23.3%-25.5%). Less time was spent moving (11.1%-10.1%) and in social activities (5.7%- 3.9%). Young leaves were the most consumed items (56.6%-79.0%), followed by ripe fruits (26.4%-11.0%), mature leaves (11.1%-5.0%), flowers (4.9%-3.1%) and other items (1.0%- 1.8%). The troops fed on 312 individual plants (74.2% trees, 16.1% climbers and 9.7% epiphytes), belonging to 31 species, in 20 families. Poulsenia armata (Moraceae) was the most important species in terms of feeding time (64.4%-81.1%) and Moraceae was the more important family (72.4%- 81.1% of feeding time). The variation in fruit abundance along time was associated with behavioral patterns and the selectivity for some particular items.

Overall, the ecological strategy does not differ much from the strategies found in lowland populations and we propose that the high population densities in the study area are the result of foliage quality and reduced interespecific competition.

Effects of tropical dry forest disturbance on herpetofaunal assemblages
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We evaluated the impact of Neotropical dry forest disturbance on anuran, lizard, snake and turtle assemblages. As species may differentially respond to disturbance, we considered species*ƒ*?T functional traits (body size, reproductive mode, foraging strategy, and habit) and habitat modification. We sampled six small watersheds on the west coast of Mexico, three conserved and three disturbed. The disturbed watersheds had agricultural mosaics of pastures, fields, logged forest, and secondary forests. In each watershed, eleven diurnal and nocturnal time-constrained searches were conducted using 10 randomly established plots (100 x 10 m) over a two year period. Eighteen anuran, 18 lizard, 23 snake, and 3 turtle species were recorded. Thirty-six species (58%) occurred in both forest conditions, 14 (22%) and 12 species (19%) only occurred in the conserved and disturbed sites, respectively. Assemblages responded differently to disturbance. Species richness, diversity, and abundance of lizards were higher in disturbed forests, while those of anuran and turtle species were lower in conserved forest. The structure and composition of snake assemblages did not differ between forest conditions. We considered species to be disturbance-sensitive if their abundance was significantly less in disturbed areas. Four anuran (22%), two lizard (11%), and three turtle (100%) species were sensitive to disturbance. No snake species was sensitive. The decline in abundance of disturbance-sensitive species was associated with the reduction of forest canopy cover, woody stem cover, and root and leaf litter ground cover. Anuran species with small body size and direct embryonic development were especially sensitive to forest disturbance. The response of herpetofauna to disturbance was differential among and within taxonomic groups.

Avifauna diversity during secondary succession of a tropical dry forest at Nizanda, Oaxaca, Mexico
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Features of habitat structure, such as vegetation height, are important for habitat selection in birds. Changes in vegetation structure and composition during successional development may influence composition of the associated avifauna. We hypothesized that composition of the avifauna would be different along the successional process. The study took place in a seasonally dry tropical forest at Nizanda, Isthmus of Tehuantepec, (Oaxaca, S Mexico). We compared avifaunal composition and the activities displayed by birds between fallows belonging to three successional development categories; young (3-8 yr), intermediate (10-27 yr), and old (35-43 yr) fallows. Censuses were conducted bimonthly throughout the year, covering both the rainy and the dry season. We recorded species richness, relative abundance (sighting frequency), and habitat use with a modified point count method. We recorded over 40 resident and migratory bird species, including two narrow endemics (Aimophila sumichrasti and

Passerina rositae). Species richness was similar in intermediate and old stages (27 and 26 species, respectively), while the young stage had a lower richness (16). Not only had intermediate and old stages more species, but relative abundance of birds also increased with fallow age, particularly for the White-throated Magpie-Jay (Calocitta formosa) and the Golden-fronted Woodpecker (Melanerpes aurifrons). Contrastingly, the Stripe-headed Sparrow (Aimophila ruficauda) was the only species exclusively observed in young fallows with large relative abundance. Low quality habitat use (i.e. perching) prevailed in young fallows, whereas high quality habitat use (i.e. foraging and nesting) was more frequent in older fallows.

Does size matters?: Feeding and activity patterns of Mexican Howler monkey (Alouatta palliata mexicana) troops of contrasting size

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At El Zapotal, Chiapas, Mexico, we studied two contrasting groups of Mexican howler monkeys (Alouatta palliata mexicana; 41 individuals in group W and 14 in group E). We hypothesized that feeding habits and activity patterns would differ between troops because of their contrasting group size. From February 2002 to March 2003 we recorded the social structure of the groups and their feeding patterns by means of focal sampling method. For activity patterns we used ad libitum sampling. Group W consumed more plant species (19) than group E (15). Group W consumed more leaves (matures 39.5%, immatures 10.9%) than group E (31.8%, 5.1%), while the latter consumed more fruits (ripe 26.8%, unripe 18.8%) than group W (24.0%, 11.6%). All activities differed between groups, except howling. There were significant differences between groups in monthly, seasonal, and annual general activity patterns ($p < 0.01$). Group E used more time resting (50.6%) and in social interactions (8.7%) than group W (36.7% and 7.4%, respectively). Group W used more time in feeding (31.3%) and travelling (19.3%) than group E (20.6% and 15.3%, respectively). In conclusion, group size influence feeding habits and overall activity patterns of howler monkeys.

Living on the edge: Roads and edge effects on threatened insular endemic rodent populations

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Road creation is a major habitat disturbance factor in tropical forests. Organisms living close to roads can be exposed to edge effects. We evaluated edge effects caused by 3-m wide roads on populations of Oryzomys couesi cozumelae and Reithrodontomys spectabilis, threatened endemic rodents from Cozumel Island, Mexico. From 2001 to 2003 we studied their populations in 16 plots (each 0.5-ha), each divided in three quadrants: one with no adjacent edges (interior forest), one with one adjacent edge, and one with two adjacent edges (corner). We used

Generalized Linear Models to analyze the effect of the number of adjacent edges on biological (abundance, body mass, corporal condition) and social (age and sex proportions, reproductive condition) variables of rodent populations. The two species showed different responses to forest edges. Oryzomys showed variation in age and sex proportions. Adult males remained mostly in the interior forest, while females and juveniles were distributed closer to edges. This species was generally more abundant closer to roads. On the other hand, Reithrodontomys showed variation in age proportion and reproductive condition. In contrast to Oryzomys, this species was mainly captured in interior forest, so individuals seem to avoid edges. Age proportion was the opposite of that found for Oryzomys; a higher proportion of adults were caught in corners, and juveniles were more abundant in the interior forest. Reproductive females were captured in higher proportion near the edges. Edge effects on both species were, in general, stronger in corners, than in quadrants with one edge, and these stronger that in the interior forest. Social effects (distribution by sex, age and reproductive state) on Oryzomys and Reithrodontomys may originate significant changes in their abundance. This may alter biotic interactions that are important for the maintenance and regeneration of forests on the island.

Bird visitation to native and exotic fig trees in South Florida
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The spread of invasive plants with animal-dispersed seeds may be constrained or facilitated by animal seed dispersal. In South Florida, hemiepiphytic figs represent an ideal way to study the influence of plant-animal mutualisms on invasion dynamics because of their obligate dependence on animal seed dispersal and almost exclusive recruitment on a single species of palm, Sabal palmetto. In this study, we evaluated the role of birds in limiting the spread of exotic figs by comparing assemblages of fruit-eating birds found visiting exotic (Ficus microcarpa and F. benghalensis) and native (F. aurea) fig trees in both natural and urban environments. Observations of bird visitation to the three focal tree species revealed similar assemblages of native resident and non-resident birds visiting the two fig species with small, soft fruit and fewer native birds feeding on the large, hard fruits of F. benghalensis. Understanding plant-animal interactions in anthropogenic ecosystems will contribute to the abillity to manage biological invasions.

Influence of the anthropogenic disturbance on the amphibians and reptiles diversity of tropical ecosystems
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The amphibians and reptiles diversity has been used as a bioindicator of the natural resources conservation status due to the specific characteristics of these organisms, which make them vulnerable to he environmental changes. Such the case of amphibians diversity reduction as a response of the rapid agricultural, cattle-raising, forestal and urban boundaries expansion in the tropical ecosystems.

Although Mexico has a very high herpetological richness, the knowledge about these groups is scarse. However, in the last years the number and quality of the herpetofaunistic studies carried out in the tropics have been increased.

The present work was done with the aim of analyze the amphibians and reptiles diversity of different environments in tropical ecosystems with different disturbance status. The studied was carried out in the south part of Chiapas state, Mexico. Where the studied environments have been forestry exploited from decades and in the last years they have been used in a sustainable way to growth cacao (Theobroma cacao).

The study was done inside of a tropical forest in three selected environments with different levels of disturbance related with the production of cacao. The diversity of amphibians and reptiles was evaluated by band transects and different diversity index were calculated based on the dominancy and uniformity criteria.

The analysis revealed that the environment with medium disturbance had the high diversity of amphibians and reptiles. Nevertheless, the differences in the diversity values obtained in the three environments were minimum.

We conclude that taking the amphibians and reptiles as bioindicators, is clear that a minimun disturbance in ecosystems with high diversity causes an environmental heterogeneity and at the same time it creates a bigger quantity of potential herpetofaunistic microhabitat. Therefore, a good management plan based on the sustainable development of the tropical ecosystems must do not reduce the biodiversity.

Impact of artifical feeders on the foraging ecology of highland hummingbirds of Costa Rica

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The use of artificial feeders constitutes a common practice among bird enthusiasts and hotels, despite that little is known on their impact on hummingbird biology. In this investigation we studied the highland hummingbird assemblage of Cerro de La Muerte, Costa Rica, and examined hummingbird feeder use, as well as seasonal changes in pollen loads in areas close and far from feeders during 4 sampling periods including dry and wet seasons from 2003 to 2005. At each sampling period we found that feeders attracted a large number of hummingbirds, but feeding bouts were dominated by the alpha species at the site, the Fiery-throated Hummingbird (Panterpe insignis). Pollen loads of hummingbirds captured near feeders were low in abundance (more than 50% of captured individuals had empty or low pollen loads) and in diversity (96% of the hummingbirds that had pollen carried only one plant genus, Centropogon). Pollen loads increased during the dry season coinciding with peaks in flower availability, although the majority of captured hummingbirds were empty of pollen. The seasonality of hummingbird abundance was consistent with patterns reported previously, reaching a peak during the dry season. In addition of decreasing pollen loads, feeders may have an impact in hummingbird spatial distribution, since it was difficult to observe and capture

hummingbirds within a 3 km radius from the feeders*f*?T location. Future studies should look at the impact of feeders on the alteration of migration routes and reproductive cycles, the definition of territories, atypical behavioral interactions among species, and the reproductive success, abundance, and distribution of highland plants and other associated species to these pollination systems.

Extinction risk for the mexican howler monkey (Alouatta palliata mexicana) in Los Tuxtlas, Mexico: Priorities between recoverying area and reconnecting forest fragments
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The loss and fragmentation of tropical rain forest led to a significant reduction in numbers of howler monkeys in Los Tuxtlas, Mexico. The study was carried out over a 4,960 ha landscape where only 11% of the original extension remains. We present a population viability analysis employing Ramas Metapop software to evaluate different effects in extinction risk and abundance of annual rates of change in fragment area and juvenile dispersal. Our results suggest probabilities of extinction near to 0.5 to the end of a 30 years interval if actual deforestation rates (4% annual estimated) in Los Tuxtlas continue. Reconnecting all forest fragments to facilitate dispersal would not diminish extinction risk considerably. We duscuss possible conservation actions for this critically endangered howler monkey subspecies.

Priority ecoregion sets for conserving Neotropical threatened anurans with distinct development modes
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Nearly 43% of all anuran species found in the Neotropical region are currently threatened. The Neotropics harbor the largest extant biodiversity areas and thus represent the last tropical region in which large-scale policy decisions can still be made. Using the WWF database of 697 threatened anuran species in 179 Neotropical ecoregions, we sought priority sets for conserving anurans, which can be separated according to their development modes into species with aquatic or with terrestrial larvae. Anurans with these different life histories respond to habitat disturbance in different ways, therefore they should be treated separately to improve conservation strategies. Priority ecoregion sets were produced by a stepwise heuristic algorithm, based on complementarity. We used ecoregions because they represent the upper scale limit at which operational choices can be considered and implemented, given that most conservation decisions and policies are constrained within national boundaries. We combined the representation of anurans within each development mode at a cutoff level of 95%. This produced a priority set of 44 ecoregions. Among these, 18 are of high priority both for aquatic and terrestrial larvae species (called an irreplaceable subset); 19 for species with aquatic larvae and 7 for species with terrestrial larvae. The irreplaceable ecoregion subset is highly concentrated in the Andes and in parts of Central America. Ecoregions that are essential to the preservation of aquatic larvae anurans are widely distributed across continents with important non-forest areas in the southern Neotropics, such as the Uruguayan savannas, the Patagonian steppe and the Argentine Espinal. Species with aquatic larvae require the integrity of two

distinct and adjacent habitats, whereas terrestrially developing anurans require primarily a well-preserved terrestrial environment. Hence, the effective selection of conservation areas in the Neotropics has to allow for differences in anuran life histories.

Mechanisms underlying adult occupancy patterns: tadpole performance in pasture, edge, and forest sites

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Although many studies have documented differences in amphibian diversity within intact and modified habitats, the mechanisms underlying occupancy patterns are little understood. Here, I examine whether the performance of tadpoles across habitat types matches patterns of adult occupancy in the same habitats. I quantified tadpole performance of two species with contrasting life histories and habitat preferences (Physalaemus pustulosus and Dendrobates auratus), in three habitats (forest, edge, and pasture) in the Osa Peninsula, Costa Rica. Tadpoles were reared in mesocosms in a randomized block design. To describe each habitat, I measured water temperature and the global site factor, a quantification of the light environment, from hemispherical photographs. Habitat treatments affected the survival, growth, and development of each species differently. D. auratus survival was low in pasture (< 5%) but higher in edge and forest (> 18%); in contrast, P. pustulosus survival was equally high in all three habitat treatments (>82%). D. auratus metamorphs were largest in edges, while P. pustulosus metamorphs were largest in pastures. Larval period did not differ among treatments for D. auratus but was shortest in pasture for P. pustulosus. Maximum daily water temperature was at least 8øC higher and daily variation in temperature was greater in pasture than in edge and forest treatments. The results suggest that P. pustulosus and D. auratus tadpoles respond differently to abiotic variables within habitats. Patterns of tadpole performance among habitats reflect those of adult occupancy, with two exceptions. D. auratus adults are not found in pastures, likely because of physiological limitations on diurnal activity in pastures. P. pustulosus adults are rarely found in forest, perhaps because edge and pasture habitats offer benefits of faster growth and development. These findings offer a more detailed understanding of the mechanisms underlying anuran occupancy patterns within neotropical forests and pastures.

Estimation of abundance of Tepezcuintle (Cuniculus paca) from track in sierra norte de Oaxaca, Mexico

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The Tepezcuintle (Cuniculus paca) is a rodent that inhabit the tropical zones of America, and although can represent and valuable source of protein and incomes to local people of rural zones, her elusive and nocturnal habits make difficult to estimate her abundance, so many field studies concluded about abundance of signs, as for example tracks and scats, or relative abundance of signals, not individuals. Although this information is valuable in the study of distribution of species, have limited utility to provide the information needed to guide a rationale use and conservation. In order to estimate the abundance of tepezcuintle in San Martin

Soyolapan, in the Municipio Santiago Comaltepec, in Sierra Norte de Oaxaca, Southeastern Mexico, we collected plaster casts of tracks monthly, from October 2006 to March 2007, five days each month. The sampling area was established along the Soyolapan River. A total of 3.36 hectares were surveyed, collecting 290 track casts (86 tracks/hectare). We selected only tracks of hind feet with clear printing of details. A total of 188 tracks were suitable for measuring with accuracy wide and length, and this ratio was used to make 10% wide intervals, taking as initial point the lower track. We assume that all tracks within the range of each interval correspond to the same individual. Our analysis showed an abundance of 3 tepezcuintles/hectare. This figure is higher than reported in other studies from Central America, where typical values are lower than one individual by hectare. The high value obtained at San Martin Soyolapan can by due to the abundance of mature oranges in the time at which the study was carried out, the presence of abundant water bodies, as well as the effect of a close season declared by local people from near five years ago.

Body size in neotropical amphibian communities and its role in predicting their conservation status.

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The increasing number of species listed as endangered and of exotic species becoming successful invaders are unequivocal symptoms of anthropogenic pressures on ecosystems. Species-level strategies may serve as a thorough way to determine the best course of action, but a macroecological approach across multiple scales may provide insights into the mechanisms underlying these changes, including early warning indicators. Here we use body size because it scales with a variety of physiological, ecological, and behavioral traits, and therefore can provide an index of their susceptibility to changes in environmental conditions at multiple scales. Specifically we ask (1) if amphibians are organized into functional groups according to body size and (2) if body size can be used as a warning indicator of the degree of extinction risk of native species and success of exotic species. To address these questions we focus on amphibian assemblages inhabiting the Caribbean islands and NW South America. We built a body size database of amphibians from the literature and museum specimens and we used the Global Amphibian Assessment database to establish the status of each species. We estimated the probability density functions of the log-transformed snout-vent lengths using a kernel-based method that identifies an optimal bandwidth. The distributions of body size were multimodal, suggesting the existence of functional groups. The size distribution of amphibian snout-to-vent lengths varied between mainland and insular habitats, and in the Caribbean among islands. In the Caribbean, Jamaica and Puerto Rico exhibited the most different distributions. In general, most of the endangered species are small, while most of the exotics are large. These results suggest that body size may be used to predict endangered species and the probability of success of exotic species.

Pollinitation and plant reproduction

WEDNESDAY JULY 18

Seedling establishment of epiphytes in coffee plantations and forests
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Coffee plantations with shade trees can be an important refuge for epiphyte diversity, but do not appear to be suitable for all species. At nine sites belonging to 3 different habitat types (natural forests, old coffee plantations and young coffee plantations) we transplanted a total of 6120 seedlings of two orchid and three bromeliad species with varying ability to colonize shade trees in coffee plantations.
Contrary to our expectations, the orchid species restricted to forests (Lycaste aromatica), had lower mortality rates than the colonizer Jacquiniella teretifolia. In both species, mortality was highest in old coffee plantations and, surprisingly, lowest in young coffee plantations. The percentage of newly formed ramets in J. teretifolia was highest in coffee plantations and lowest in forest sites, whereas the opposite is true for seedling growth of L. aromatica.
Our results indicate that the differential colonizing ability of epiphytes might be the consequence of higher seedling growth rates of colonizing species whereas seedling mortality seems to be less important.

Dispersal modes and fruit morphology of tree species in the tropical rain forest of Mexico
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Based on the revision of the floristic and taxonomic literature, specimens housed at the herbaria of the Field Museum of Chicago (F), as well as field observations, we recorded 935 species, 337 genera, and 83 families of trees for the tropical rain forest in Mexico. The largest numbers of species per family were recorded for Rubiaceae (109), Euphorbiaceae (62), Lauraceae (37), Melastomataceae (42), and Mimosaceae (42), while at the genus level Psychotria (43), Miconia (30), Eugenia (23), Ocotea (21), and Inga (20) are the most speciose. The most abundant fruit types were berries (24%) and drupes (21%). The most common fruit colors were black (34%), brown (22%), and red (18%). Fruit sizes varied mainly among the ranges 10.1ƒ?"316 mm2 (62% of species). The number of species located in the lower stratum was 324, in the middle 223, and in the upper 387. A highest percentage of species has likely to be biotically dispersed (74.6%), followed by autochory (16%), and anemochory (9.4%). The comparative analysis between dispersal modes and related strata demonstrates that only those species with anemochorous fruits are positively correlated with the upper stratum. The results

of this study reflect a wide morphological diversity of the fruits of the trees in the Mexican tropical rain forest, and its complex relationship with the vertical gradients of vegetation and dispersal modes.

Germination and seed viability of Bursera copallifera (DC.) Bullock (Burseraceae), a common tropical dry forest tree of Morelos, Mexico

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Tropical dry forest restoration in Morelos is hindered by poor germination of Bursera copallifera and other common Bursera. Preliminary work found that the stony endocarp of B. copallifera is water-permeable and that mechanical scarification does not improve germination. In an effort to find treatments that promote germination, the following were applied to 1250 seeds collected from several mother trees at the locales of Teocalco and Quilamula, Morelos: 1) deionized water (control), 2) moist pre-chill for 6 days at 4C preceded by a 48 hr imbibition period at room temperature, 3) 250 micromolar gibberellic acid (GA3), 4) 600 micromolar 6-benzyladenine (BA), and 5) 125 micromolar GA3 plus 300 micromolar BA. Germination of each mother tree collection was tracked separately for comparison. Logistic regression analysis found that the most important effects on germination were the variation between the mother tree collections ($p < 0.0001$, alpha = 0.05), with 18 to 72% germination, and the tree*treatment interaction ($p = 0.0005$), where each mother tree collection responded differently to the treatments. The treatment effect was minimal ($p = 0.0432$). The only statistically significant response was that prechilling decreased germination for one mother tree collection. Because none of the treatments improved germination for all of the collections, none are recommended as a general germination promoter for B. copallifera. Only 3% of the total seeds remained viable at the end of the 51 day test period. The estimated proportion of viable seeds for each mother tree collection varied from 0.19 to 0.81, and the means for the locales were 0.27 and 0.47 for Teocalco and Quilamula, respectively. Low viability and vigor were the most important factors limiting germination in this study. The results suggest a possible relationship between seed viability and tree density or population structure that should be examined more closely.

Propagation by cuttings of four Bursera species

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The genus Bursera has a large number of species in the Tropical Dry Forests of Mexico. Many species are dominant or co-dominant elements of mature forests, and they are usually typical elements of late succesional communities. Therefore, its propagation and later reintroduction could be a important for the ecological restoration of disturbed sites. However, seed germinability is low in many species, and thus propagation by cuttings could be a good alternative to produce high quality plants in a short period of time. A previous essay showed that cuttings of several Bursera species have the capacity to produce roots, but it is necessary to establish the specific conditions leading to successful root development for each species. We present results on callus and root formation in cuttings of four Bursera species abundant in the Mexican state of Morelos: B. lancifolia, B. glabrifolia, B. copallifera and B. linanoe in response to four concentrations of Indol-butiric acid (0. 1500, 4000 and 9000 ppm). Root

development in cuttings from adult and juvenile trees is also compared, and recommendations for the successful propagation by cuttings for each species are given.

Seed rain after a fire in a xerophytic shrubland
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Dispersal of seeds is crucial for vegetation recovery after disturbance. Fire mainly causes the death of different plant structures, basically of those that are not isolated from high temperatures, as well as a reduction in above soil plant cover. This work studied seed rain composition and abundance in a xerophytic shrubland one year after a fire, in rainy and dry seasons. One burned and one unburned sites were chosen, 32 seed rain traps were placed on each. Twice a month, for one year, material in traps was collected. Dispersal syndromes of the species in the seed rain were characterized. One hundred morphospecies were found in burned site, 89 in unburned one. Total abundance values were 233,686 (45.64/m2) in burned site, and 100,387 (19.6/ m2) in unburned one. Significant differences in seed rain abundance were detected due to the season $F_{1,124(gl)}= 65.61$, $p<0.05$. Fire showed a significant effect on seed rain richness $F_{1,124(gl)}= 33.13$, $p<0.05$) as well as the season $F_{1,24}$ (gl)= 109.61, $p<0.05$. Dominance index showed a higher value in burned site (0.79), while diversity index value was higher in the unburned one (1.59). The most frequent dispersal syndromes were associated to wind dispersal. The highest values of abundance in seed rain were observed in the dry season, which is a result of the phenologic features of this shrubland. Fire can affect the richness of seeds in dispersion in different ways, the fact that there was a greater abundance registered in the burned site can be a result of a decrease in plant cover values due to fire. Nevertheless, it affected some species negatively, since some of them were present in smaller abundances in the burned site. Further studies on seed dispersal dynamics are needed to explain changes in plant composition and diversity and how it is affected by perturbations.

Vegetative propagation of some tropical dry forest native species in abandoned agriculture lands in Nizanda, Oaxaca.
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To explore the potential of tropical dry forest (TDF) species for reforestation, we evaluated the establishment ability and cover development from stakes for five TDF native species in abandoned agriculture fields. The research was conducted at Nizanda, Isthmus of Tehuantepec (Oaxaca), S Mexico. Two experimental studies were carried out. First, 400 Bursera simaruba 50-60 cm long stakes were planted at the onset of the rainy season, and 400 more at the end of the dry season in six fallows (3, 7, 16, 23 and 38 yr old, and one in mature forest). Four months after planting, survival of B. simaruba was very low, with 3.6% and 0.3% at the rainy and dry season, respectively. Due to high mortality, we were unable to evaluate the effect of plot age on the establishment ability. Although this species showed promise, stake size may have not been optimal. In the second experiment, we quantified survival and growth of five species planted in a newly abandoned field at the end of the dry season. We used generalized linear models for the statistical analysis. Nine months after planting, Amphipterigium adstringens had a relatively high establishment success (20-26%), whereas B.

simaruba, Gliricidia sepium, and Jatropha alamanii had lower values, and did not show differences in survival. Gyrocarpus mocinnoi failed to establish. Stake survival was influenced by size; a greater initial height resulted in greater survival. According to the variable used in evaluating growth (diameter, cover, length of the longer sprouted branch, and number of sprouts), each species presented a unique behavior. In order to make precise recommendations,it is necessary to explore other propagation alternatives.

Seed bank variability among agriculture fields in a tropical dry forest region
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In early successional stages the regeneration process of plant communities depends primarily on the composition and size of the soil seed bank. Relatively few studies have assessed these two characteristics of seed banks in tropical dry forests with anthropogenic disturbance. The objective of this study was to evaluate seed bank heterogeneity among agriculture fields differing in edaphic conditions in a tropical deciduous forest in southern Mexico. Seed bank composition and density were evaluated (at the end of the rainy season and in the middle of the dry season) in twelve agriculture fields classified in three groups according to soil characteristics (sandy soil; black limy soil; and clayey soil). Composed samples totaling 804.16 cm2 in surface were obtained at each site. Seed bank characteristics were investigated through seed germination in greenhouse conditions during 16 weeks. Mean seed density and species richness of germinated seeds were lower in rainy season samples than in dry season samples (1253 vs. 3434 seeds/m2, 25 vs. 37 species, respectively). Herbs were the most abundant life form in the soil seed bank (> 90% of germinated seedlings), whereas trees were poorly represented. No significant differences were found in the agriculture fields seed bank related to edaphic conditions. Rather, seed bank characteristics appear to have been more strongly influenced by history of land use, a factor that was not initially controlled for during site selection. The highest values of species richness and density were found in the older agriculture fields, whereas younger fields had the lowest ones.

Seed bank successional variation after slash-and-burn agriculture in a seasonally dry tropical forest
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Knowledge on the regeneration strategies in tropical dry forests (TDF) has increased considerably in recent years, yet information on seed bank contribution to the regeneration process is still scarce. Given the harshness of environmental conditions during part of the year, the sprouting ability of many TDF species, and the high seedling mortality frequently observed, seed banks in these forests appear to play a reduced, but variable role in forest regeneration. This study was conducted in Nizanda, Isthmus of Tehuantepec (Oaxaca, Mexico), and its aim was to understand the potential contribution of the seed bank during succession following slash and burn agriculture. Soil samples were taken from 17 fallows conforming a successional chronosequence (2-50 yr of abandonment), and from a mature forest stand, in both the rainy and the dry season. Four soil samples each comprising four subsamples (8 cm diameter, 5 cm

depth) were taken at each fallow by season. Soil samples were thinly spread in trays on top of a vermiculite/agrolite mixture. Changes in species richness, species composition, and seed density of the soil seed bank were analyzed along the chronosequence. Both species richness and seed densities were higher after the dry season than after the rainy season. Also, these two properties had higher values at early successional stages, and decreased with stand age slowly but steadily. The seed bank was dominated by forb (Malvaceae) and grass species; few trees were represented, although the abundance of Mimosa acantholoba (Fabaceae) was high at mid-age stands. Similar to studies in tropical moist forests, our results indicated that the composition of older secondary stands is less dependent on seed bank characteristics.

Sex ratio, growth rates and phenology of C. schereberiana, a dioecious tree in the Luquillo Forest Dynamics Plot, Puerto Rico

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The theory of plant reproductive costs suggests that because resources required for fruits and seeds are greater than for pollen production, female plants grow more slowly, begin flowering later in life, or have a higher mortality rate than males. In addition, life history differences result in populations with a male biased sex ratio, and earlier male flowering in each reproductive season. To compare life history traits of male and female C. schereberiana, we censused trees three times between July 2006 and March 2007 in the 16 ha Luquillo Forest Dynamics Plot (LFDP), and identified their gender from flowers. Population structure and relative growth rates were compared using LFDP census data from 1990 to 2000. As predicted, there were significantly more males than females (557 males: 477 females, ØÎ2 = 6.19 p<0.05). Males began flowering earlier than females with a significantly male bias during the first part of the reproductive season (82 males: 41 females, ØÎ2 = 13.66, p<0.05). The male bias was less, and not significantly different during the middle (187 males: 160 females ØÎ2 = 2.10, p>0.05) and late (463 males: 411 females ØÎ2 = 3.09, p=0.05) parts of the season. The size class distribution of males and females was not significantly different (ØÎ2 = 0.26 p=0.9) and there was no difference in growth rates. Our results support the theory of reproductive costs as it relates to time of flowering and the population sex ratio, however, we found no evidence for male versus female differences in size or growth rate. Sex differences in growth and mortality rates will be assessed during future LFDP censuses.

Floral morph and cross type effects on germination and seedling survival of Ruellia nudiflora (Engelm. & Gray) Urban (Acanthaceae)

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The perennial herb Ruellia nudiflora has been shown to exhibit two flower morphs in the Yucatan Peninsula: purple corollas and white corollas, the former being present at much higher frequencies. In addition, this species has a mixed reproductive system as it produces both

chasmogamous and cleistogamous flowers. The goal of this study was to determine the effects of flower morph type and cross type on R. nudiflora germination and seedling survival in Yucatan, Mexico. Our prediction was that purple morph seeds and seedlings would show the highest germination and survival rates. To test this hipothesis we selected plants in the field from each morph to conduct the following crosses: cross-pollination both within and between flower morph types, and self-pollination for each morph type (seeds from cleistogamous fruits). Two weeks after crosses were performed, the resulting seeds were used in a field experiment, consisting of five blocks in each of two sites (S1, S2) (n= 250 seeds). S2 was characterized by already having both flower morphs naturally occurring in it, while S1 had the purple morph only. Daily and weekly censuses were conducted in order to monitor germination and survival across a 6-month period. Germination did not differ significantly between cross types, but did between sites. On the other hand, after 6 months of observation the data suggest that survival differs significantly between cross types and sites, and that these factors interact significantly: seeds from cleistogamous fruits showed the greatest survival rate at S2, while at S1, seeds from cross-pollination between morphs showed the highest survival. Together, these findings suggest that the higher frequency of the R. nudiflora purple flower morph type is not due to a greater germination ability. Differential survival across sites suggest the potential for local adaptation of white flower morph plants.

Seed production and autonomous self-pollination ability differ between the narrowly distributed I. rubriflora and its widespread congener I. purpurea (Convolvulaceae)

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Features that determine the persistence and colonization ability of species may influence regional distribution patterns. Therefore, narrowly distributed plants may show less reproductive success than their widespread congeners, because of less pollinator visitation rates or less autonomous self-pollination ability. The objective of this study is to examine whether the individual reproductive success, levels of autonomous self-pollination, pollinator richness and visitation rates differ between the narrowly distributed annual Ipomoea rubriflora (Convolvulaceae) and its widespread congener I. purpurea. Data were obtained from two sites of Bosque Chaqueno Serrano, a subtropical dry forest from central Argentina. Sites were located at the distributional boundaries of both species where they grow sympatrically. We obtained three measures of individual reproductive success in five randomly marked individuals in each population: fruit set, seed set and total individual seed production. Pollinator richness and visitation rates were obtained from floral censuses. Autonomous self-pollination fruit and seed set were evaluated in five individuals from one population. We obtained a relative measure of autonomous self-pollination ability by comparing autonomous self-pollinated and natural levels of fruit and seed set. Natural individual fruit and seed set did not differ between species. However, total individual seed production was lower in I rubriflora. This species was pollinated by one species of hummingbird, whereas I. purpurea was pollinated by several Hymenoptera and Lepidoptera species. However, visitation rates did not differ between species. Relative autonomous self-pollination fruit set was lower in I. rubriflora, but seed set did not differ between species. The lower total individual seed production of the annual vine I. rubriflora may determine its lower current abundance at the populations studied and may limit

the colonization of new sites. Indeed, its lower autonomous self-pollination ability may determine more dependence on pollinators to produce seeds and therefore, less ability to buffer adverse years in pollinator service.

Recruitment patterns in tree species with different dispersal strategies in Peruvian Amazonian forest

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We analyzed the variation of seedling recruitment density in six tree species with different dispersal strategies in a 50 m ratio around adult trees. We defined two groups according to their dispersal strategies: (GI) species with fruits or seeds with reward and high density of mature fruits in the canopy, and (GII) species with fruits or seeds without reward and high density of mature fruits in the floor under the canopy. According with these dispersal strategies, species of GI would display high seedling density far from adult trees because their fruits would be dispersed by animal that visit the canopy. On the other hand, species of GII would display high seedling density under the canopy because their fruits or seeds without reward which are not depredated would not be dispersed by animals that visit the forest floor. We selected three adult trees every six species; by individual we arranged eight 50 m transects. Where we placed plots to measure the seedlings density (0,20 - 2 m. of height). Seedling density and distance to adult trees did not differ among the studied species (Chi=14.87, P<0.09). Nevertheless, two species of GI tended to have high seedling recruitment far from adult trees. The seedling density and distance to adult trees of one tree species of GII adjusted to a logarithmic equation (F=9.97, P=0.013, R2 adj.=0.50), in which seedling density tended to be lower as distance to adult trees increased. Our data suggest certain trends that need to be examined with more tree species (replicates) in order to identify recruitment patterns more clearly between the dispersal strategies.

Microenvironmental factors of seedling establishment and growth of a harvested understory palm, Chamaedorea radicalis

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Harvesting non-timber forest products provides income for rural communities and can be an incentive for conservation. Leaves of the understory palm Chamaedorea radicalis are harvested in northeast Mexico for sale as floral greenery. This harvest is extensive in Alta Cima, an ejido in the El Cielo Biosphere Reserve (Tamaulipas), that has conducted enrichment plantings in the forest to supplement wild C. radicalis populations. We are investigating what microsite environmental factors affect seedling establishment, survival, and growth to inform future enrichment plantings. In May 2006 we measured seedlings from 2003 seed and seedling plantings along with microenvironmental factors. For seedlings planted as seeds, the best predictors of size [length of the youngest fully expanded leaf (YFL)] were layers of leaf litter, distance to nearest sapling, humus depth, and distance to nearest tree (a multiple regression model R2=0.13). All four significant variables were positively correlated with length YFL. For transplanted seedlings, number of leaves was best predicted by canopy openness

and distance to sapling (model R2=0.08). For length of YFL of transplanted seedlings, rock cover was the only significant predictor; seedlings in plots with rock cover > 1% had longer leaves than those in plots without rocks (ANOVA F=4.03). These data suggest the best microsites for C. radicalis seedling growth are rocky open sites away from trees and saplings, but with deep humus and leaf litter. Seedlings will be recensused in June 2007 to further assess microsite effects on growth, as well as their effects on survival.

Is Gymnopodium floribundum (Polygonaceae) a clonal tree?

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This study took place in a tropical dry deciduous forest in the archeological park of Dzibilchaltun in the Yucatan peninsula of Mexico. This project forms part of a larger study looking at the ecology and physiology of trees in tropical dry deciduous forests. Gymnopodium floribundum (Polygonaceae) a small tree with shredded bark is quite abundant in Dzibilchaltun, and previous studies by our group indicate that it presents a strong clumped distribution regardless of location near or far to a source of water. This strong clumped distribution led us to suspect Gymnopodium may be able to reproduce asexually as well as through the production of flowers. We have found morphological evidence (presence of rhizomes and stolons) for the asexual reproduction of Gymnopodium. Our data also suggest that asexual reproduction may be linked to environmental factors such as light availability. We are currently in the process of analyzing DNA from leaf samples of Gymnopodium to determine the extent of a genet in this species.

Biotic seed dispersal of the columnar cacti Neobuxbaumia mezcalaensis (Bravo) Backeberg in the Tehuacan Valley

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Seed dispersal of plants which regeneration dynamics depends on facilitation process, constitutes a crucial process where the determination of dispersers effectiveness, depends on quantity and quality of seed removal, and the features of the sites where seeds are placed by dispersers.
In this work we analyze the seed dispersal stage of the columnar cacti Neobuxbaumia mezcalaensis from the disperser effectiveness with special emphasis in the quality of the sites where the seeds are deposited. The quality of the sites will depend of the physical environment modification from the different nurse plants and the intraspecific and interspecific interactions that occurs in the context of positive interactions.
These results show that N. mezcalaensis seeds are mainly dispersed by birds and bats, being the bats the most effective dispersers. The bat effectiveness is enhanced with the plants used as a perch, due to these microhabitat may have different effects over seeds and seedlings develop, these differences relies on biotic and abiotic process and such process are the main basis to suggest that identification of disperser effectiveness constitutes a complex net interactions that is necessary to understand to set the seed dispersal role in population dynamics.

Ovule fate in Bauhinia brevipes Vog. (Fabaceae), an endemic species of Brazilian Cerrado

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The goal of this study was to evaluate ovule fate in Bauhinia brevipes (Fabaceae), a bat-pollinated, self-incompatible shrub, and endemic of the Brazilian Cerrado. Fruit dispersal occurs ballistically at the onset of the rainy season. In October 2005 ripe fruits were collected (n=60) in Tres Marias, Minas Gerais, southeastern Brazil. Total fruit length and total ovule number was recorded. Ovule fate in each position within the legume was classified as: unfertilized, predated, aborted and apparently viable seeds. The relationship between unfertilized ovules, predated, aborted, viable seeds, and fruit size (explanatory variable) was tested through regression analysis with binomial error corrected for over-dispersion. The analyses were followed by residual analyses to test for the suitability of the models and error distribution. Mean fruit size was 13.49 ñ 2.1cm (range from 8.7 to 17.8cm) with 18.3 ñ 3.3 ovules per fruit. From the 1,119 analyzed ovules, 14.9% were unfertilized, 9.6% were predated by Bruchidae (Coleoptera) and most ovules (61.5%) were aborted at some stage of development. As a result, only 166 (13.9%) ovules developed in apparently viable seeds. Late acting self-incompatibility may account for the high proportion of aborted ovules. The proportion of unfertilized ovules was negatively related to fruit size ($F= 15.011$, $p < 0.001$), suggesting pollen limitation. However, no correlation between preyed upon ($F= 0.589$, $p= 0.44$), aborted ($F= 1.4727$, $p= 0.23$) or apparently viable seeds ($F= 1.289$, $p= 0.26$) with size fruit was found. Nearly 80% of the apparently viable seeds germinated, regardless of light condition (complete darkness or 12h-photoperiod). Large reproductive losses are a result of a combination of factors such as pollen limitation, herbivory and resource limitation.

Phenotypic plasticity in seed germination of Miconia albicans SW Triana (Melastomataceae): are there phylogenetic constraints?

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The Cerrado ranges from dense grassland (campo sujo- CS), with a sparse covering of shrubs and small trees (cerrado- CE), to closed woodland with a canopy height of 12ñ15m (cerradao- CD), offering a unique opportunity to evaluate phenotypic plasticity (PP) in plants occurring in these physiognomies. The PP in seed germination of Miconia albicans, a widespread Cerrado shrub, was studied at southeastern Brazil. In Dec 2006, fruits were collected at CS, CD and CD and seeds were set to germinate in Petri dishes covered with double filter paper sheets. The dishes were incubated at constant temperature of 25§C, at a 12-hr photoperiod and complete

darkness. For each treatment, 50 seeds were placed in each Petri dish (n=8) and data were analyzed through ANOVA, followed by Tukeyƒ?Ts test (×ñ =0.05). Seed water contend did not differ among seeds collected in the three physiognomies (F=2.68; p=0.12). PP was observed in seeds submitted to 12h-photoperiod; germinability at CS (76.5 ñ 7.61%) was significantly lower than that in CE (88 ñ 5.95%) or CD (91.3 ñ 6.32%; F=10.81; p=0.002). Mean germination time was lower at CD (8.34 ñ 0.61 days) and higher at CS (11.84 ñ 0.49 days; F=109.98; p < 0.001). Germination in darkness was never greater than 2.5%, but when dark-exposed seeds were transferred to 12h-photoperiod, germination occurred. Again, germination at CS (24.25 ñ 5.1%) was lower than at CE (58.3 ñ 5.45%) and CD (72.57 ñ 5.1%; F=22.6; p < 0.001). PP in light-exposed seeds is likely to be a result of maternal effects during seed development. Lack of PP in dark-exposed seeds might be a phylogenetically-constrained trait because small-sized seeds are prevented to germinate in dark. Therefore, it is expected that small Melastomataceae seeds do not respond to environmental variation since they lack enough reserves to allow germination when buried.

Propagation of Lavoisiera imbricata (Melastomataceae), a common species from Brazilian rock outcrops with economic potential

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The EspinhaCo Range of Brazil, a UNESCO humanity patrimony, hosts the high altitude Cerrado, in which occur rock outcrops where the spatial heterogeneity lead to high plant diversity and endemism. Many species exhibit economic potential as ornamentals, medicinal or for land reclamation. The use of native species in landscaping and degraded land reclamation projects is important due to better adaptation to local abiotic and biotic conditions. This could lead to conservation of native species which are threatened by predatory harvesting. This approach also provides social sustainable economic development as reinforced by public policies based on the Convention on Biodiversity. Propagation of this flora is little known despite the needs for rare plant reintroductions, degraded land restoration and economic use. We aimed do develop a propagation protocol for Lavoisiera imbricata (Melastomataceae) a common and abundant species of EspinhaCo Range that has economical potential. We studied phenology and soil chemical and fisical characteristics such as pH, fertility and field capacity. We tested modern in-vitro and routine traditional substrate germination experiments. We germinated seeds in 7 substrates (including natural occurrence) in greenhouse, and a factorial 3x3 design of sucrose and salt treatments in culture media. Data were normalized and analyzed by ANOVAs. Flowering occurred all rainy season and mature fruit with developed seeds were available during 6 months. The soil showed high overall nutrient availability, field capacity and organic matter but the pH was low (4,0). Germination on substrates was 6 times grater than in-vitro but the second technique provided more homogeneous seedlings. Natural, horticultural and horticultural+sand (1:1) substrates provided best germination (>20%). In vitro germination was overall low and with no signifficant differences among treatments. Our results showed that production of rupestrian species` seedlings is economically viable and that the continuity of propagation studies is important for their sustainable local use.

Rarity effects of micro-habitat, phenology and reproductive succes in two Gesneriaceae from the endangered Brazilian rock outcrops.

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Differences in micro-habitat, phenology and reproductive success between two rupestrian species of Gesneriaceae were investigated. Paliavana sericiflora (PS) and Sinningia rupicola (SR) are phyllogenetically close and differ in occurrence range, habitat specificity and extinction threat. They are sympatric in the iron rock outcrops of Minas Gerais State (MG), one of Brazil`s most endangered habitats. PS screes in several habitats of all kinds of rock outcrops above 1000m in the southern portion of ƒ?oEspinhaCo Rangeƒ?? in MG. SR is a range restricted species that screes only in shaded crevices of iron rock outcrops above 1.400m in ƒ?oQuadrilatero Ferriferoƒ?? in southeastern MG. We aimed to investigate whether micro-climatic stress, reproductive traits and also interaction between phenollogy and edafo-climate are related to rarity degrees. Photossintetically active radiation (PAR) and soil fertility were evaluated at both speciesïs micro-habitats. Umidity contents of substrates, air temperature, air umidity, wind speed, precipitation, and solar radiation were followed to investigate association with phenology. The reproductive potential and success were determined by the probabilities of mature fruit and viable seed productions. Both micro-habitats present reduced PAR in comparison to open sites, but the substrate of SR was more humid and fertile. Growth and reproduction of SR were restricted to wettest months with seed dispersal at the end of the rainy season after which all plants remained dormant as tubers for 6 months. Growth of PS occurred almost all year long, with flowering during all rainy season. The fruits matured slowly and dispersed seeds only at the next rainy season. SR presented higher reproductive success but PS presented higher reproductive potential due to greater fruit and seed productions.These results are usefull to understand niche and autoecology as rarity factors in the Brazilian Cerrado`s rock outcrops and may help its conservation planning.

Reproductive success of Laelia speciosa (HBK) Schltr. (Orchidaceae) in two populations under different disturbance conditions in Michoacán, México.

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Laelia speciosa is an endemic and endangered Mexican epiphytic orchid. Previous studies have shown that L. speciosa is dependent on its pollinators for its sexual reproduction, primarily for outcrossing, although it is also capable of selfing. The objective of this study was to assess female and male reproductive success of L. speciosa in two populations under different perturbed conditions. We predict that the reproductive success of L. speciosa will be negatively affected by human disturbance. We evaluated female reproductive success by recording production of fruits, seeds and their viability; male reproductive success was evaluated by pollinia removal. We also conducted a series of hand pollinations to determine if this orchid is pollen limited. The results indicated that the fruit set was greater (23.6%) in the more disturbed than in the conserved population (9.7%); nevertheless, the number of seeds per fruit was lower in disturbed population (495 153 and 657 630 respectively). Male reproductive success and seed viability were similar between sites. In conclusion, fruit set in both populations is low under natural conditions, but our hand pollination experiment suggest that female reproductive

success is pollen limited in L. speciosa; this has been reported for many species of Orchidaceae. Differences in reproductive success between sites could be due to more activity of the generalist pollinator Apis mellifera in the disturbed site. It was recognized that Bombus pennsylvanicus sonorus and B. ephippiatus (Hymenoptera) are the main pollinators of L. speciosa in less disturbed sites

Sexual Reproduction and Pollination Agents of Chamaecrista glandulosa var. mirabilis (Leguminoseae: Cesalpinioidea)

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The pollen transference, known as pollination, is a process on plants that involves the relationship of a physical agent. In this case, the in relationship is between hymenopterans and Chamaecrista glandulosa var. mirabilis, an endemic and endangered plant of Puerto Rico. Its populations are found on the Laguna Tortuguero Natural Reserve. Its habitat is open areas of silica sands with high temperatures. Individuals of C. glandulosa were treated to measure the pollination capability of the population. To study the autogamy possibility or buds were placed in small wire mesh bags which prevented the interaction of pollinators or visitors. Other buds were used as experimental controls. Flowers with mature anthers were collected and its pollen was analyzed and characterized. Usually the flowers individuals were visited during early hours in the morning by hymenopterans. Some last ones of these visitors observed and analyzed in the laboratory to study the presence of the pollen on thers bodies and determine if they were pollination agents. The pollinators were identified Xilocopa virginica (Apidae) and bees of the family Andrenidae, which apparently also visit and might pollinate other plant species. The plants with bagged buds did not produce fruits of so autogamy was discarded or reproduction in this species. The buds used as controls produced fruits, suggesting that its sexual is based on the interaction with pollinators.

Determination of reproductive characteristics of Lulo Solanum quitoense and effect of the pollination with Bombus atratus (Hymenoptera: Apidae) on the production.

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In Colombia the Lulo (Solanum quitoense) has taken special interest in the fruit panorama of the country in the last 10 years and in different regions of the national territory due to its economic potential. However, little is known about its life history and its interaction with pollinator insects. Bombus atratus (Hymenoptera: Apidae), is bred in captivity and is employed as a successful pollinator of some commercial solanaceas.

This study had the main objective to evaluate the effect of the pollination with the bumblebee Bombus atratus on the quality of the fruits of Lulo in terms of size, number of seeds and uniformity of the fruit. On the other hand the study proposes a pollination system that improves the culture production, from the quality of the fruits to the reduction of production costs by

generation of a friendly atmosphere with the pollinators.

Lulo displays an andromonoecium system, with flowers of long and short stigmas, but only flowers with long stigmas develop fruits. The plant displays flowers all the time throughout its cycle, with several flowers in anthesis by cluster and several clusters by plant. They are frequently visited by the bumblebees in sunny days or days without rain between 10:00 and 15:00. The flowers do not have nectaries, and for this reason the bumblebees visit them as source of pollen for the feeding and construction of their nests.

Pollination and seed dispersal patterns in three successional stages in a Tropical Dry Forest in southeastern Brazil

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Tropical Dry Forests (TDF) are the most threatened of all major tropical forest. The TROPI-DRY network was created for the understanding of the structure and dynamics of TDF ecosystems and it*ƒ*?Ts regeneration (successional stages) in the Americas. Pollination and seed dispersal are determinants of the composition and structure of communities, and are intrinsically associated with successional processes. We aimed to determine the prevalent pollination and seed dispersal syndromes in TDF communities and how do these syndromes differ among different successional stages. The study was conducted in Mata Seca State Park, a conservation unit located in southeastern Brazil dominated by seasonal TDF, from November 2006 to March 2007. All individuals with a living woody stem of DBH equal to or greater than 5 cm were identified in 6 early, 6 intermediate, and 6 late successional stage plots (20m x 50m), and their pollination and seed dispersal syndromes were inferred from flower and fruit morphology and from literature information. On 63 species (25 families), seven pollination syndromes -wind, beetles, moths, bees, small insects, hummingbirds and bats- and three seed dispersal syndromes -zoochory, anemochory, autochory- were identified. Bee-pollinated trees predominated in all successional stages (46.15%, 58.06%, and 54.76%, early, intermediate, and late stages, respectively). Hummingbird pollination occurred only in the early stage (3.85%), while beetle pollination in the late stage (2.38%). Seed dispersal patterns differed among the three successional stages, with a prevalence of autochorous species (51.9%) in the initial stage. In the intermediate and late successional stages most species were anemochorous (approximately 50%), while autochorous and zoochorous species accounted for approximately 20% in each stage. Regardless the differences on vegetation structure and plant species diversity between the successional stages, the patterns of pollination syndromes were very similar, in accordance with others studies. The dispersal syndromes were also in accordance with other studies.

Pollinator attraction to different flower morphs of Bauhinia pauletia Pers (Fabaceae)

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Bahuinia pauletia (Fabaceae) is an andromonoic, self-compatible plant that is frequently visited by bat pollinators. In this study we compare floral characteristics (nectar volume and concentration) and pollinator visits between hermaphroditic and male flowers of B. pauletia to test the hypothesis that masculine flowers and plants with a greater proportion of masculine: hermaphroditic flowers attract more pollinators. The study was conducted in tropical dry forest at the Chamela-Cuixmala Biosphere Reserve, Jalisco, Mexico. Nectar production and sugar concentration were measured in 9 hermaphrodite and 8 masculine flowers. Nocturnal video filming was used to document pollinator activity for 5 hermaphroditic and 11 masculine flowers starting at anthesis for 6 continuous hours. The number of masculine and hermaphrodites flowers within a plant were counted in 8 individuals of B. pauletia during 4 nights. Contrary to our predictions, hermaphrodites produced a significantly greater volume of nectar than masculine flowers, while no difference in sugar concentration was observed between the flower morphs. Potential pollinators that visited B. pauletia included small moths (Noctuidae), large moths (Sphingidae), and the nectarivorous bat Leptonycteris curasoae; however, only bats touched the stigma and anthers and thus may serve as effective pollinators. No significant differences were found between flower morphs for Noctuidae or L. curasoae; however, Sphingidae visited hermaphroditic flowers significantly more than male flowers. A greater proportion of masculine flowers was found compared to hermaphroditic flowers within individual plants; furthermore, flowers on plants with a greater proportion of male flowers received greater total visits. Although we found no evidence that male flowers possess characteristics that effectively increase pollinator visits, the greater proportion of male flowers found within plants suggests that the presence of the male flower morph is important for increasing total pollinator visits and presumably individual plant fitness.

Pollination Biology of Agave potatorum in the Tehuacan-Cuicatlan Valley, Mexico

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Many species of agaves (sub-genus Agave) present floral characteristics associated to chiropterophily. Some authors have proposed the Tehuacan Valley as the center of specialization in the chiropterophylous pollination system of columnar cactus and paniculated agaves, due to the permanent presence of the nectarivorous bat Leptonycteris curasoae in the zone. In this work was tested the hypothesis that A. potatorum depends exclusively of the bats for their pollination in the Tehuacan Valley. Pollination treatments were made to determine the efficiency of the pollinators and the mate system of the species, also analyzed floral biology. The results show that A. potatorum is self-incompatible and, in opposition to the initial hypothesis, it presents a generalist pollination system, in which diurnal and nocturnal visitors present similar efficiencies. This system could be favored by the extension of the reproductive function (the stigmatic receptivity). We discuss that the competition by pollination could be the cause of the generalism founded.

Morphological variation in flowers of the sexually polymorphic tree Jacaratia mexicana (Caricaceae)

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Separation of male and female structures in different individuals (dioecy) occurs in approximately 4% of flowering plants, and can be as high as 10-30% in tropical habitats. In most dioecious species, the spatial segregation of the sexes between individuals is imperfect, and plants often produce reproductive organs of the opposite sex. In this study we document variation in floral structures in the dioecious tropical tree Jacaratia mexicana (Caricaceae). J. mexicana is sexually dimorphic in both flower size and number, with male plants producing smaller and more numerous flowers than female plants. We found that, as in other dioecious species, female plants produce only pistilate (female) flowers, while a fraction of male individuals are sexually variable. Sexually variable males produce pistilate and perfect (hermaphroditic) flowers in addition to staminate (male) ones. To characterize the distinct types of flowers, we measured 26 morphological variables with the aid of stereoscopic and electron microscopy. Our results indicate that: 1) pistilate flowers from male trees carry healthy-looking ovules, and are morphologically similarƒ?"although smallerƒ?"than pistilate flowers on female plants; 2) perfect flowers produce healthy-looking ovules and pollen, but have smaller ovaries than pistilate flowers and fewer anthers than staminate flowers; and 3) staminate flowers have a rudimentary, non-functional pistil, and are the only flowers capable of producing nectar. Our morphological analysis of sexual variation in J. mexicana provides some insight into the evolution of dioecy in this group. First, the observation that sexual variation is restricted to male trees is consistent with the evolution of dioecy via the gynodioecious pathway. Second, the production of pistilate, staminate and perfect flowers in the same plant suggests that the evolution of more complex reproductive strategies such as trioecy (separate male, female and hermaphrodite individuals), is not bound by hard developmental constraints in the production of different sexual floral types.

Nectar traits of bat-pollinated flowers in a Tropical Dry Forest

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Spatial and temporal patterns of nectar production influence foraging decisions and foraging movements of bat pollinators. In addition, specific nectar characteristics are likely to affect foraging decisions, as well. To better understand the dynamics of the interaction between nectar bats and their plant resources in the tropical dry forest we investigated nectar characteristics within the community of chiropterophilic flower species in the Chamela-Cuixmala Biosphere Reserve in the Pacific coast of Jalisco, Mexico. We focused on traits likely to influence batsƒ?T foraging decisions, namely nectar secretion rate, energy content, and sugar composition (glucose, fructose, and sucrose). We addressed the following questions: (i) is nectar volume secreted by flowers negatively correlated with nectar energy concentration? (ii) do higher energy concentrations compensate for lower nectar volumes, resulting in similar total energy contents among flower species? (iii) do chiropterofilic flowers produce hexose-

dominated nectar, as compared to sucrose? and (iv) does the sugar composition vary with nectar volume and energy concentration? We collected nectar from 703 chiropterophilic flowers belonging to 12 plant species and 6 families. Nectar was extracted 2 hours after anthesis using capillary tubes. Sugar concentration and composition were analyzed using refractometry and Medium Infrared Reflectance method, respectively. Correlation tests indicate that flower species offering the greatest nectar volumes tend to produce less energy-concentrated nectar. However, this relationship was weak, and the total energy available in flowers remained first and foremost dependant on nectar volume. Nine of the 12 flower species produced hexose-dominant nectar, and hexose-rich species offered significantly greater nectar volumes than sucrose-rich ones. These results are examined in relation to alimentary preferences of bats and with the blooming patterns of plants (big-bang, patchily distributed vs. steady-state, scattered, nectar production). Possible implications of these nectar characteristics on foraging movements and decisions are discussed.

Plant physiological ecology

WEDNESDAY JULY 18

N and P Resorption in Trees of Different Ecological Groups of the Mexican Tropical Rain Forest
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In the tropical rain forest, nitrogen and phosphorus resorption in tree species vary widely without a clear explanation. In order to find a possible answer, nutrient resorption proficiency was related in 24 tree species with their regeneration strategy. It was hypothesized that nutrient resorption would differ depending on the species regeneration strategy. Obligate gap species would resorb less nutrients than gap-independent species owing to higher nutrient availability in their soil microhabitats. In the southern part of Mexico (Los Tuxtlas, Ver.) 100 g of freshly fallen leaves were collected from trees of 8 obligate gap, 8 gap-dependent and 8 gap-independent species. Leaf nitrogen and phosphorus of the trees was determined along with the soil nitrate, nitrite and available phosphorus of the root zone at 10 and 30 cm depth. Obligate gap species had lower concentrations of leaf N% (1.01) than the gap-dependent (1.30) and gap-independent species (1.36) (P = 0.023) indicating higher resorption proficiency. By contrast, phosphorus did not show differential resorption (O = 0.091, D = 0.096, I = 0.107 P%, P = 0.59). Soil under obligate gap species at 10 cm depth had lower amounts of nitrate and ammonium (nitrate: O = 15.02, D = 28.1, I = 17.85 mg/kg, P = 0.0009; ammonium: O = 26.93, D = 25.53, I = 48.7 mg/kg, P = 0.0008), being a possible cause of the higher nitrogen resorption. They also showed higher amounts of soil phosphorus (O = 13.63, D = 8.14, I = 6.79 mg/kg, P = 0.04). The study showed that variation in nutrient resorption in the tropical rain forest can be related to the functional groups of tree species, and that nutrient resorption may strongly be influenced by their soil availability.

Stem and leaf hydraulics of congeneric tree species from adjacent tropical savanna and forest habitats
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In central Brazil, forest species can invade adjacent savanna habitats when fire is excluded. However, this process is very slow. We predicted that, besides fire tolerance, differences in plant water relations between savanna and forest species may predetermine the relative success of savanna over forest species in boundary habitats. To investigate the intrinsic differences between plants of the two functional types in water relations, we investigated leaf and stem hydraulic traits for six congeneric species pairs, each composed of one tree species typical of savanna habitats and another typical of adjacent forest habitats. Measurements were performed on individuals all occurring in savanna habitats to exclude the effect of

environmental variances. Most stem hydraulic traits including wood density, xylem water potentials at 50% loss of hydraulic conductivity, specific hydraulic conductivity, and leaf area specific hydraulic conductivity did not differ significantly between savanna and forest species. Leaf hydraulic conductance and its related trait leaf capacitance, however, both tended to be higher in savanna species. Predawn leaf water potentials, a variable reflecting plant rooting depth, and leaf mass per area were also found to be higher in savanna species in all congeneric pairs. Hydraulic vulnerability curves of stems and leaves indicated that leaf water conducting system was much more vulnerable to drought-induced loss of hydraulic function than that of terminal stems, regardless of genera and functional types. Our results suggest that the major differences between forest and savanna species are in leaf, not stem, hydraulic traits. Compared to forest species, savanna species depended mainly on a combination of deeper root systems, large leaf capacitance to water storage, and higher leaf hydraulic conductance in adapting to the drought-prone environment of savanna habitats.

Are leaf and stem hydraulics determinants of dieback in tall Sclerolobium paniculatum savanna trees?

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Leaf and stem hydraulics of the dominant Sclerolobium paniculatum (Leguminosae) tree species in Neotropical savannas of central Brazil (cerrado) were investigated in an attempt to understand their potential role on the die back of larger individuals of this species. Diurnal variation of leaf hydraulic conductivity, leaf and stem vulnerability to cavitation, and water relations were studied in individuals of different size. Compared to smaller trees, large trees exhibited higher abundance of branch damage, more dead individuals, higher wood density and leaf mass per area, as well as lower leaf area per branch and lower leaf area/sapwood area ratio. Stem specific hydraulic conductivity (Ks) did not change between dawn and midday, however Ks tended to be lower in taller trees and in trees containing dead branches. Leaf specific hydraulic conductivity (Kl) did not change with tree size. Compared to other savanna woody species, S. paniculatum had high Ks and low vulnerability to cavitation. Large trees also had lower maximum leaf hydraulic conductivity (Kleaf) compared to smaller trees, and all tree sizes exhibited a lower Kleaf at midday but recovered in the evening, suggesting potential diurnal refilling of embolized conduits in leaves. Leaves had substantially higher vulnerability to cavitation than stems. There were adjustments in leaf and branch hydraulic architecture with increasing tree height (Ks was lower so a smaller leaf area/sapwood area was required to maintain constant Kl with tree size). The ultimate cause of mortality in larger S. paniculatum trees may be due to an unsustainable situation in terms of carbon allocation and whole tree carbon balance, indicated by stem and leaf hydraulics. It is hypothesized that large trees get a extremely poor return in carbon gain from their investment in stem and leaf biomass compared to small trees.

Hydraulic Architecture and Reverse Sap Flow in dwarf Rizophora mangle plants

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A comparative study of water relations and hydraulic architecture between coastal (tall) and inland dwarf mangroves was carried on in Biscayne National Park (Florida). Soil water potential (Ø^s) was measured in both sites across the soil profile from 10 to 120 cm deep. Sapwood area, specific hydraulic conductivity (Ks), leaf area specific hydraulic conductivity (Kl) and sap flow were measured in dwarf inland and tall coastal mangroves. In the coastal site the differences in Ø^s between the 10 cm and the 120 cm soil layer were -0.45 MPa while in the inland area the difference was -1.54 MPa. This Ø^s gradient is the driving force for hydraulic redistribution of soil water. Reverse sap flow was detected at nighttime in roots and stems of dwarf but not in tall R. mangles. Midday leaf Ø^ of tall and dwarf trees were significantly different (-3.8 and -2.3 MPa respectively). Also predawn leaf Ø^ of the dwarf R. mangle was lower than the tall R. mangle (-1.6 and-0.5 MPa respectively) indicating that in the inland site there is a source of fresh water at depth. Predawn leaf Ø^ of dwarf mangroves were lower than the average soil Ø^s suggesting that reverse flow may inhibit Ø^ equilibrium between soil and plants at nighttime. Sapwood area, Ks and Kl were significantly lower in dwarf than in tall R. mangle. Midday Ks and Kl were significantly lower than predawn values in dwarf R. mangle. Net assimilation rate of dwarf R. mangle was lower than tall R. mangle. These findings suggest that nocturnal reverse flow affect the water relations of mangrove plants, resulting in water deficit, lower net CO2 assimilations and lower leaf surface area in dwarf R. mangle which might be detrimental for growth and could partially explain the small size of inland R. mange plants.

Environmental controls over foliar nutrient concentrations in tropical rainforests

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Within the tropics, mean annual precipitation (MAP) is expected to be one of the most important climatic variables affected by global warming. To predict the effects that changes in precipitation caused by climate change could have on tropical plant communities, it is key to understand the interaction among precipitation, nutrient cycling, and forest function. Studies have shown that primary productivity increases with precipitation reaching a maximum value at 2445mm MAP, and then decreases in sites with very high precipitation (> 3000mm MAP). Although the mechanisms driving this pattern are still uncertain, a potential explanation is a decrease in nutrient availability in very wet sites. In this study we explored soil nitrogen (N) and phosphorus (P) bioavailability and foliar nutrient (N and P) concentrations of common tree species in 9 rainforest sites in Costa Rica, which ranged between 3500-5500 mm MAP and with elevations between 50-1000 m. We tested the hypothesis that nutrient bioavailability decreases with increasing precipitation, potentially causing the observed pattern of diminished productivity in high rainfall sites. For soils, both net nitrogen mineralization (range: 0- 3.7 æg/g*d; r2 = 0.44, p = 0.07) and net nitrification (range: 0.77-4.48æg/g*d; r2 = 0.44, p = 0.01) decreased as MAP increased. However, total % N (range: 0.35- 0.79 %; r2 = 0.58, p = 0.03) increased with altitude, but did not correlate with precipitation. Melich extractable P was low in all sites (less than 1æg/g). Foliar %N was higher for legumes than for non-legumes (T=12.4, p,< 0.001), but did not directly relate to either precipitation or soil nutrient availability. We concluded that although mineralization and nitrification rates suggest a decrease in available nutrients in sites with very high precipitation, other environmental controls, such as altitude or species composition may also be important in determining nutrient status and productivity in

rainforests .

Characteristics and controlling factors of photosynthesis of Camellia Sinensis leaves in rubber-tea community in Xishuangbanna

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Large areas of rubber-tea community are distributed in Xishuangbanna. Studying the photosynthetic characteristics and controlling factors of tea leaves in community, is instructive for the practice of rubber-tea intercropping as well as tea planting. In this paper, diurnal variations of photosynthesis of Camellia Sinensis leaves from rubber-tea community at low (570 m) and high (870 m) elevations in Xishuangbanna were studied under natural conditions. The responses of tea in community and pure tea plantation to light were also compared. The results indicated that maximum net photosynthetic rate (Pmax), dark respiration rate (Rd), light compensation point (LCP) and light saturation point (LSP) in tea leaves of rubber-tea community were significantly lower than those of pure tea plantation. The diurnal variations of net photosynthetic rate (Pn) in leaves of community at the two elevations showed a single peak. Photo flux density (PFD), Pn , transpiration rate (Tr) and stomatal conductance (Gs) in leaves of high elevation were significantly higher than those of low elevation. The correlation analysis demonstrated that PFD was the main controlling factor causing photosynthetic differences between tea leaves from community with different altitudes. Improved light condition under canopy increased net carbon gain in tea leaves, therefore, arranging rubber-tea community with more focusing on tea plantation at high elevation may increase economic benefit totally.

Ecological interactions between columnar cacti and perennial plant along a stress gradient

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Ecological interactions between columnar cacti and perennial plant along a stress gradient

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In recent years, it has been proved that in plant-plant interactions, physical environment directly influences the balance between facilitation and competition. Therefore, it has been hypothesized that in a stress gradient, plant interactions shift from positive, in high abiotic stress conditions, to negative in relatively benign environments. The purpose of this work was to test this hypothesis along a hydric gradient in the Tehuacan-Cuicatlan Valley. To determine the interaction effects, we analyzed association-repulsion patterns, cacti abundance and richness. To determine the interaction mechanisms, the performance of two columnar cacti species was evaluated experimentally removing its neighbors. In xeric sites, our results showed that cacti were associated with perennial plants and that aggregate distribution positively affected cacti richness. In contrast, in mesic sites, cacti distributed uniformly, and presented a repulsion effect to trees and shrubs. Moreover, we found that cacti diversity decreased because of low light levels produced by neighbors. Experimental results showed that in less stressful

environments, the performance of individuals improved when their neighbors were removed; while in more stressed environments, targeted individuals had a lower performance. This work concluded that along the stress gradient, competition prevails in mesic environments, but shifts to facilitation when arid conditions are stronger. This study presents new empirical evidence that confirms the stress-gradient hypothesis in the processes that structure the communities dominated by columnar cacti.

Diurnal variation of chlorophyll fluorescence in leaves of the "Bana" vegetation of the Amazon

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The Amazon ƒ?oBanasƒ?? occur on sandy podzolized soils of the upper Rio Negro basin. Here, the ƒ?oBanasƒ?? occupy relatively higher parts along an elevation gradient. These communities are composed of low-stature trees with scleromorphic leaves, which have a remarkably ability to restrict leaf water loss by stomata closure at the time of maximal irradiance. Under such conditions, leaves fully exposed to sun could absorb more photons that they can utilize, and this may reduce the efficiency of Photosystem 2 (PS2). To assess this hypothesis, leaf chlorophylls (Chl) a and b concentrations were analyzed, and midday (MD) and predawn (PD) chlorophyll fluorescence (F) parameters (initial, Fo; maximum, Fm and variable, Fv) were measured in expanding (EL) and adult (AL) leaves. The measurements were done in six dominant species: Catostemma sancarlosianum Steyerm, Heteropterys sp, Macairea rufescens DC, Pachira sordida (RE Schult.) WS Alverson, Remijia morilloi Steyerm and Rethyniphyllum concolor (Spruce ex benth.) Mull. Arg. The Chl (a+b) and Chl (a/b) were 169 mmol/m2 and 2.1 in EL, respectively, which contrasted with values in AL with 432 mmol/m2 and 3.1, respectively. Thus, immature EL has a relative small photochemistry capacity of PS2 compared to AL. The Fv/Fm at MD was about 0.61 and 0.65 in EL and AL, respectively, but it increased up to 0.69 and 0.74 at PD, respectively. Thus, these species underwent dynamic inactivation of PS2 at MD, as Fv/Fm increased overnight. This represented acclimatization down regulation associated with photoprotection without damaging PS2. Moreover, diurnal changes of Fv/Fm were paralleled by modification of Fm with slight changes in Fo. This suggested the activation of photoprotective mechanisms related to the xanthophylls cycle in these species at the time of maximal irradiance. Relatively lower overnight recovery of Fv/Fm in EL could be associated with their low photochemistry capacity in immature leaf tissue.

Characteristics of plant photosynthesis, soil respiration and their effects on diurnal change of overstory carbon flux in a tropical rain forest in Xishuangbanna, Southwest China

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For discussing dominant uppermost canopy trees photosynthesis and soil respiration effects on diurnal change of canopy carbon flux in tropical rain forest, we analyzed the characteristics of

diurnal change of dominant uppermost canopy tree photosynthesis and soil carbon fluxes in three seasons from 2003 to 2004 in Xishuangbanna tropical rain forest. The results showed that: the photosynthesis of three layers in three seasons all showed significant diurnal patterns. The photosynthetic rate of whole overstory in the dry season reached the peak at about 12:00 hours local time. In the rainy season, the photosynthetic rate increased gradually and reached the peak at 16:00 hours local time. CO2 fluxes of the overstory in two distinct seasons (dry season and rainy season) were significantly ($P<0.001$) correlated with the photosynthesis. The correlation equations were: $Fc=-1.4516Pn +0.0886$ ($R2=0.8305$, Dry season) and $Fc=-1.8896Pn +0.4292$ ($R2=0.9044$, Rainy season), respectively. The diurnal photosynthesis of the four plant seedling species also showed different patterns. In the three treatments, the CO2 fluxes of the treatment (soil+litter+seedlings) was the highest. CO2 fluxes of the overstory were highly correlated with photosynthesis in the different seasons. The CO2 fluxes of overstory were found to be negatively correlated with the mean photosynthesis of the seedlings. However, the soil CO2 fluxes were poorly correlated with the mean photosynthesis of the seedlings. Collective use of these methods (and other methods uncovered in the future) can provide clues to the workings of the ecosystem and the atmospheric boundary layer and therefore may increase our confidence level of the carbon flux estimates.

Ecology and ecophysiology of tropical hemiepiphytes

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The astounding diversity of plant species and life forms characteristic of tropical forests has inspired numerous ecological and ecophysiological investigations. Despite their notable success in neotropical forests, however, hemiepiphytes remain both ecologically and physiologically poorly understood. To determine their contribution to forest diversity, hemiepiphytic Araceae and Cyclanthaceae plant communities were censused in primary and secondary forest at La Selva Biological Station, Costa Rica. Striking differences exist between the families, with Araceae having notably higher species abundance and richness than Cyclanthaceae. Overall, the greatest community diversity was found in swampy, lowland habitats of primary forest. Community structure differed substantially between primary and secondary forest sites. Hemiepiphytes of both families were much lower in abundance and diversity in secondary forest. Only in older secondary forest stands, with greater than 20 years re-growth, did species richness approach values close to those found in primary forest. Cyclanthaceae hemiepiphytes were virtually absent in young secondary forest stands. Manipulative shadehouse experiments examined ecophysiological response under varying light levels between species of the different families. The comparatively lower growth, conductance, and gas exchange rates of Cyclanthaceae species could indicate a greater sensitivity to environmental conditions, which may explain the significantly lower abundance and diversity of this family compared to Araceae.

Comparison of physiological responses of deciduous and evergreen species in a tropical dry deciduous forest

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Tropical dry deciduous forests are among some of the most endangered ecosystems of the world, yet information on the ecology and physiology of plants in tropical dry forests is still scarce. Trees in dry forests present a variety of adaptive physiological responses to the high evaporative demand and prolonged dry season found in these ecosystems. Gaining insight to these adaptations is a necessary first step in predicting the impact of global climate change and in planning a sustainable management of the forests. This study took place at the height of the dry season (May 2005 and 2006) in the dry deciduous forest of Dzibilchaltun, Yucatan, Mexico. Gas exchange (LiCor 6400), apparent electron transfer rate (Heinz-Walz GmbH MINI-PAM Photosynthesis Yield Analyzer), and leaf water potentials were determined for two evergreen (Gymnopodium floribundum, Diospyros cuneata) and one brevi-deciduous (Piscidia piscipula) species. Overall the brevi-deciduous species (Piscidia piscipula) tended towards higher average apparent electron transport rates, light saturation points, and water potentials; and a lower average NPQ (heat dissipation) value when compared to the two evergreen species (D. cuneata and G. floribundum). Preliminary data for the evergreen species Gymnopodium floribundum suggest chronic photoinhibition in this species; however, Gymnopodium also presented the highest within species variation in physiological responses. Physiological differences among species suggest different strategies among evergreen and brevi-deciduous species. The high variability within Gymnopodium floribundum may be related to differences in the life history pattern of this species.

Transplant of palms xate (Chamaedorea elegans and Chamaedorea ernesti-augustii) in forests sucesionales in Frontera Corozal, Chiapas.
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The high deforestation rates and pressure of agriculture have modified large areas originally covered by tropical rainforests into farms. When these lands are abandoned, they are colonized for native species of fast growth, initiated the process of early secondary succession. Give an aggregate value to the secondary forests, opens the possibility to maintain to the remanent forest patched, generating financial gain would reduce the pressure on primary forest and increased the restoration of degraded areas. The enrichment of secondary forests with plant species of high commercial value, as the case of palms xate (Subgenera Chamaedorea), is a viable option, because the leaves of these palms have a high demand in the industry of flower growing in Mexico and other countries. The present study evaluated the dynamics leaves, the survival and the growth of palms of Chamaedorea elegans and C. ernesti-augustii transplanted to secondary forests (3, 7 and 20 years) and old forests. The utility of these secondary forests for the development of productive plantations was explored, to identifying the forests that maximize the production of leaves and the survival of the palms. Analyses of hemispherical photographs revealed that canopy openness and light availability were significantly greater in 3 years sucesional forest than in primary forest C. elegans y C. ernesti-augustii, the maximum leaves production was registered in the secondary forests of 20 years. The results indicate that the optimum performance of the palms transplanted occurs in the forests sucesionales of 20 years. Nevertheless twelve months after the transplant the palms continue under a period of acclimation.

Tropical legume seeds and seedlings: initial nitrogen allocation of Inga seedlings
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Legumes are known for their high nitrogen demand and nitrogen rich seeds. This study quantified the percent nitrogen (N) in seeds of seven Neotropical Inga trees in order to determine the proportion of seed N initially allocated to seedling tissues (leaves, stems or roots). Seeds were analyzed for N content and germinated to determine initial N concentration in seedlings. It was hypothesized that large seeds would have higher percent N and seedlings would allocate more N to leaves than roots or stems. Percent seed N was significantly different among species ($p < 0.001$), lowest in Inga goldmanii and highest in I. spectabilis. Seedlings allocated greater N to leaves than stems or roots (5%, 4%, 3.7%, $p < 0.001$). Seed N results were surprising because the smallest seeded species did not have the smallest percentage of N, whereas the largest seeded species had the largest percent N indicating that as a genus, Inga allocates similar amounts of N proportional to seed biomass to seeds, however the initial proportion of nitrogen that is allocated to seedlings differs (0.47-0.98 mg N seedling / mg N seed). These differences may be indicative of different growth strategies of individual species. Future research will quantify the total proportion of seed N transferred to seedlings.

Soil Quality and Allometry in Syagrus glaucescens Becc., an Endemic and Threatened Palm of the EspinhaCo Mountains, Brazil

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Syagrus glaucescens is an endemic palm from the rupestrian fields of the EspinhaCo Range, MG, southeastern Brazil. It is highly associated with quartzitic soils and presents strong morphological variation at different areas where it occurs. Allometric measures were used here to verify whether there are any significant differences in the morphological traits between the populations located in two areas. At the Serra do Cipo, the individuals presented decumbent stems whereas at the region of Diamantina the stems are straight and perpendicular to the ground. Soil quality was evaluated and related to the plant morphological traits to test the hypothesis that the allometric variation is determined by soil nutritional differences. The stem shape and size differed significantly between the two regions; individuals at Serra do Cipo were shorter and had fewer leaves when compared to individuals from Diamantina. The soils of the two regions differed in the water retention capacity and in the nutrient absorption. At Serra do Cipo, the soils were more acid, with higher aluminum saturation and lower sandy content. These traits correlated with the stem shape and indicated that soil acidity and aluminum saturation plays a role in the architecture of S. glaucescens.

Fluctuating asymmetry on leaves of Calotropis procera

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Fluctuating asymmetry (FA) is a particularly useful measurement of developmental stability because, for bilaterally or radially symmetrical traits, the optimal phenotype is known. Individual- and population-levels of bilateral FA have been related to several biotic and abiotic stresses. Some studies have shown correlations between FA and phytophagous insect attack due to higher nutritional quality of asymmetric leaves compared to symmetric leaves. We tested the hypothesis that plants with a higher FA should be more susceptible to herbivore attack in a stressed area. We evaluated FA on Calotropis procera, an invasive species found in tropical arid regions. C. procera occupies the semi-arid northeastern region of Brazil, but is rapidly spreading to central and southeastern regions. It is colonizing the Cerrado, Atlantic rain forest and Caatinga (seasonally dry forest). The study was carried out in Serra Talhada and Alagoinha in Pernambuco State between August and November of 2006. Five branches were randomly collected from 41 plants on each sampling period. Each leaf was identified, digitized, dried and weighed. Total leaf area and area lost to herbivory were evaluated with an imaging software. FA was recorded for two morphological leaf traits: leaf width, and inter-rib distance, taken in the right and left sides of the leaves. The percentage of leaf consumed by herbivores was different between Alagoinha (28.92 %, n=332) and Serra Talhada (9.60%, n=1261), while the mean leaf surface for Serra Talhada (0.65 ñ 0.08 cmý) and Alagoinha (0.59 ñ 0.06 cmý) did not differ statistically (p>0.05). More area was removed by herbivores on young leaves compared to mature and old leaves. No significant relationship between FA and leaf area removed by herbivores was found between sites.
(CAPES/PROCAD).

Demographic performance of the clonal understory herb Calathea marantifolia (Marantaceae) in different light environments

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It is known that many understory plants in temperate and tropical zones reproduce using both sexual and clonal propagules. However, it is not known if the demographic performance of adults and their propagules are equal in high and low light environments. To address this issue I established eight demography plots, four in tree-fall gaps and 4 in the shady understory, in Corcovado National Park, Costa Rica. Within each plot, I marked individuals (N = 1251 for all plots) in August of 2004 and began to follow their survival (biannual), growth (biannual), and reproduction (monthly during reproductive season). The effects of light on seed germination and survival were determined experimentally in wire mesh boxes (8 seeds per box, 10 boxes per plot). Canopy openness was used as a proxy for light availability which I estimating annually for each plant using the canopy scope technique. In high light plots the size distribution was skewed, with a higher proportion of larger plants compared to low light plots. Surprisingly the threshold size for reproduction was lower in the low light plots than in the tree-fall gaps. Contrary to the hypothesis of a trade-off between sexual and asexual reproductive modes, fruit production and the size of clonal propagules were both greater in high light plots than in the shady understory. These data suggest that demographic performance of Calathea marantifolia is dependent on light availability, and perhaps as tree-falls gap close the vital rates of light demanding species may change.

Inter-specific variation in plant functional traits in response to a resource gradient in secondary tropical forests La Selva Lacandona, in Chiapas

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We evaluated variation in aboveground and belowground biomass and morphology of 36 species of seedlings in a chronosequence of secondary forests at La Selva Lacandona, in Chiapas. Our objective was to assess which functional traits let them establish in specific micro-habitats in order to form functional groups that could be used as tools for restoration projects in disturbed ecosystems.
We predicted that early sucesional species (pioneers) would be more efficient in capturing soil limiting resources by having grater belowground biomass and surface, while species from late succession (shade tolerants) would have grater aboveground surface and biomass allocation to increase light capture under the forest canopy.
We collected ten seedlings per species and per site along the chronosequence and measured traits related with leaf and root surface and biomass allocation. We found no difference in root/shoot biomass allocation in species along the resource gradient or between the successional strategies (pioneers, intermediates and tolerants). In terms of morphological variation, we found that species that establish in early sites have larger values of specific leaf area (SLA) and leaf area ratio (LAR), larger specific root length (SRL), and deeper roots per leaf area (RD/LA) than species from late forests. They also have longer root length per leaf area (RL/LA). These results suggest that early species are more efficient in belowground resource capture, by having longer, thinner and deeper roots than late species, and develop thinner and larger leaves. On the other hand, late sucesional species have thicker leaves, which may reflect a grater allocation to reserve or defense in light-limited environments, and shorter, thicker and shallower roots. These results provide evidence of the strategies of resource allocation in relation to habitat variation and might be useful as indicators of success in recruitment of seedlings in degraded areas according to their use of resources.

Effects of dehydration/hydration periods on germination of Ipomoea wolcottiana tree (Convolvulaceae) in a Mexican tropical dry forest.

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Ipomoea wolcottiana (Convolvulaceae) is a fast-growing pioneer tree which colonizes gaps and disturbed areas of dry tropical forest in Chamela Jalisco, Mexico. Seed dispersal of I. wolcottiana is in March and April before the rainy season. During the dry season, sporadic and unpredictable rainfall can occur, causing drastic changes in soil temperature. As a result seeds can be exposed to periods of hydration/dehydration and soil temperature fluctuations. In these periods seeds can trigger some metabolic processes, which not necessarily finish with germination, but can involve carbohydrate or other food reserve mobilization, and finally favouring seed germination and seedling survival when the rainy season is established. The aim of this study is to evaluate whether these hydration/dehydration periods causes metabolic changes during I. wolcottiana seed germination. To achieve this objective we are determining temperature and soil moisture after each raining episode, as well as seed germination, levels of food reserves (carbohydrates, lipids, starch and proteins). I. wolcottiana seeds were collected during seed dispersal, enclosed in mash bags and buried in two sites (open and closed) where soil temperature was recorded daily. Seeds were exhumed after each rainfall event until the

rainy season was established. Buried seeds from the open site and different exhumation times showed fast and higher germination percentage seeds than closed and control, although imbibition rate was similar in all treatments. Meanwhile, levels of carbohydrates were higher in seeds from closed site and different exhumation times than control and open site seeds. Currently, we are analyzing levels of lipids and proteins in seeds of the different treatments. So far our results show that hydration/dehydration-temperature periods (hydrothermal time) might be causing changes in food reserve mobilization, seed germination and thus seedling survival.

Temperature and light effects on seed germination of endemic Asteraceae species from rupestrian fields

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The rupestrian fields are one of the most endangered physiognomies of the Brazilian Cerrado (savanna). In an attempt to provide data for plant species propagation and conservation, we evaluated the effects of light and temperature on seed germination of two native rupestrian field shrubs: Mikania sp. (colonizing sandy soils) and Richterago sp. (colonizing rocky outcrops). Mature fruits were collected at Serra do Cipo, Minas Gerais, southeastern Brazil, and set to germinate in Petri dishes covered with double filter paper sheets. The Petri dishes were incubated at B.O.D. chambers at constant temperatures of 15, 20, 25, 30 and 35§C, at a 12-hr photoperiod and complete darkness. For each treatment, 25 seeds were placed in each Petri dish (n=4) and data were compared with ANOVA, followed by Tukey*ƒ*?Ts test (×ñ =0.05). Mean germination time (MGT) was calculated for all treatments. Germination of Richterago sp. achenes (type I and type II) was also tested. Temperature significantly affected germination of both species. Germinability of Mikania sp. seeds at 20§C (39.5%) and 25§C (37.5%) were higher than at other temperatures. For Richterago sp., optimum germination was achieved at 20§C. For both species no significant light effect was observed. Neither light nor temperature influenced MGT. Dimorphic achenes of Richterago sp. significantly differed in seed germination as achenes of type II did not germinate in any of the experimental conditions. Seeds of both species are considered non-photoblastic, meaning that buried seeds can germinate. Temperature-dependent germination may not be an important factor affecting the substrate colonized by those species. Low germination might be the result of high levels of empty seeds, a common trait in Asteraceae.

Understorey light availability and variation influences seedling response in disturbed montane forests

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1. We described the understorey light environment at different spatial scales in terms of light availability (average) and variation (min, max, or variance) within a focal area of different size.

2. To evaluate light effects on growth of five tree species (differing in their shade tolerance) seedlings (N=596) transplanted in the forest understorey. In order to detect at what scale each species respond? Plant growth could be explained by light availability or by light variation? Which of the light variation forms were relevant to explain plant performance?
3. We suggest that plant response to light availability may be detected at different scales in each species, and that this grain may be related with their shade tolerance. We hypothesized that less tolerant growth will depends on light availability at small scales and to minimum value while more tolerant will respond at larger spatial scales. and because of their light use efficiency to maximum light value.
4. In eight plots with a central gap we evaluated direct light (DSF%) with hemispheric photographs (N=982), 2.5m from each other, and plant growth, (stem height and basal stem diameter) over a period of 75 months. To explain plant response multiple linear regression were fitted with mixed effects models including time and light availability or light variation, (fixed effects).
5. Light availability was relevant to explain stem height of all species but at different scales, minimum light value explained all species growth at any scale, maximum light value was related with tolerant species growth (Persea, Quercus) and Alnus (intolerant)
6. These results indicate that, plant performance depends on relative conditions of the light environment in addition to point-level values, and the scale may be helpful to distinguish tolerance level. Criteria for functional classification of tree species may consider heterogeneity of light environments at different scales.

Influance of habitat characteristics on Annona glabra in South Florida
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Pond apple (Annona glabra) is a small tree native to wetlands of the neotropics. In Australia and some Pacific islands, pond apples are an invasive exotic, threatening ecosystem stability. Historically, South Florida hosted large, dense monotypic stands of pond apple. Due to intensive human disturbance in the Everglades ecosystem, these large stands no longer exist. Understanding the habitat preferences of pond apple including ecological factors that lead to dense stands in its native habitat, may aid restoration efforts and prevent the further spread of pond apple in regions where it is invasive. In January 2007, we collected data on the density and distribution of pond apple in relation to habitat characteristics in 13 sites within the Florida peninsula, south of Lake Okeechobee. Habitat characteristics quantified included canopy cover, soil/water pH, percent leaf damage and habitat type. In contrast to pond apple populations in Australia and what was historically reported in Florida, we found no dense, monotypic stands of adult trees. Habitat characteristics that were significantly related to pond apple density and distribution include soil pH, habitat type and canopy cover. Specifically, pond apples were denser and less clumped in hardwood swamps and more clumped in areas with high pH. We discuss the implications of these results for conservation and further research.

Divergences in the plastic response to water level between dry and humid habitat species of a tropical dry forest
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In the landscape on the dry forest of Chamela, Jalisco it has been detected a differential distribution of plant species. This distribution responds to gradients of soil water availability. In the present study we explore the morphological response to contrasting levels of soil water availability between seedlings of six pairs of congeneric species specialized to dry or to humid habitats. Assuming that temporal and spatial variation of soil water availability is higher in dry habitats, we predict that specialists to dry habitats will have a stronger plastic response in their morphology to levels of experimental irrigation. The seedlings of each species were grown in two soil water treatments (low and high) for a period of 90 days. At the end of growth season, the seedlings of each treatment were harvested and we proceed to obtain the next morpho-functional traits: root:shoot ratio, specific root length, total root length:leaf area ratio, elongation rate of the main root axis, specific leaf area, leaf area ratio, wood density and stem water holding capacity. For most of traits and genera we found no evidence of differences in plastic response to water availability between specialists of dry and humid habitats. Contrary to our prediction, when we found differentiation in the plastic response, the dry specialists exhibited the less plastic response. In conclusion, plants that are specialized to the more stressing and variable habitat didnƒ?Tt have a higher plastic response to the low soil water availability treatment, as we predicted.

What's in Droseras' diet?
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Drosera capillaris Poir. is one of five species of carnivorous plants in Puerto Rico. Itƒ?Ts also found in North America, Greater Antilles, Central America, Trinidad, and British Guiana. Our objective was to know what was Droseraïs diet and how diverse would it be. Our study site was at Tortuguero Lagoon Reserve, north of Puerto Rico. This is a subtropical moist secondary forest with siliceous sands. The microhabitat of Drosera capillaris was characterized: soil was physically and chemically analyzed, and data on climate was recorded. This soil is poor in macronutrients; nitrogen, phosphorus, and micronutrients like magnesium, and manganese as well. We observed the plants and collected some of the insects that were trapped by the plants. They were preserved in 70% ethyl alcohol and observed under a microscope to be classified. Five families of insects have been classified: 2 species of long-legged flies (Diptera: Dolichopodidae), a beetle (Coleoptera: Lathrididae), dark-winged fungus gnat (Diptera: Sciaridae), pygmy mole cricket (Orthoptera: Tridactulidae) and crane flies (Diptera, Tupulidae). The diet seems diverse although most of the insects found are long-legged flies. Insects are very small, ranging from 1 mm to 4 mm.

Functional analysis of palm allometry: do morphological constraints determine palm distribution across light environments?
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Palms represent one of the most conspicuous groups of Angiosperms in Tropical Forests. Although their contribution to overall species diversity is small, they influence forest structure and dynamics, and play an essential role in foodwebs. The distribution of palms reflects fine shifts in environmental heterogeneity and light availability. In arborescent species, adaptation to fine gradients is constrained by the capacity to increase in height and provide crown support while maintaining structural stability. The lack of a vascular cambium determines habitat colonization and resource allocation across gradients of light environments, influencing overall palm structure and architecture. We first analyzed the allometry of the stem height vs. stem diameter in eight neotropical palms representing a wide range of habitat and regeneration requirements across different successional sites in Costa Rica (Euterpe precatoria, Prestoea decurrens, P. acuminata, Geonoma edulis, Chamaedorea tepejilote, Cryosophila warscewiczii, Iriartea deltoidea, and Socratea exhorriza), and then evaluated overall palm structure by considering stem diameter, stem height, number of leaves, and the structure of the stilt root cone using a Principal Component Analysis (11 morphological variables). We found a strong logarithmic relationship between stem diameter and height. With the exception of the understory palms G. edulis and C. warscewiczii, shaded palms under 1.5 m had significantly lower slopes relative to palms that escaped the light-limited understory, which grew 4-9 times faster. The first principal component (71.4% of the variation) had a homogeneous contribution of most of morphological variables, with the exception of the number of functional leaves, which dominated the second principal component (11.7%). Our results showed that species that differ significantly in size and light requirements shared a common solution to structural problems. Understanding these allometric relationships provides insight in determining how physical limits to morphological diversity influence the distribution and abundance of tropical palms.

Ontogenetic plasticity of biomass allocation in response to above- and below-ground resource availability in perennial shrubs: a case study of two species that differ in ecological breadth

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Optimal partitioning models predict that plants should adjust biomass partitioning to minimize imbalance in any critical resource, while the more developmentally explicit model predicts that ontogenetic plasticity should be most profound in response to inadequate light or CO2 availability, and should be negligible or greatly reduced in response to inadequate nutrient or water availability. In this study, we tested the developmentally explicit model in two perennial shrubs, Lippia alba and Lippia origanoides, that differ in ecological breadth. Both species occur in Colombia: L. alba is widely distributed along the country and inhabits open or partially open

sites, whereas L. origanoides is restricted to habitats with soils poor in nutrients and with high incidence of solar radiation. This study system allowed us to expect a more dramatic response to light limitation, because the positive correlation between phenotypic plasticity and ecological breadth. We report its adaptive changes and ontogenetic drift of root/leaf allocation in response to different resource levels (i.e., light, water and nitrogen availability) by comparing root/leaf allocation on a size basis. The root/leaf allocation of both species decreased with the size (i.e., ontogenetic drift) during the growth, and exhibited significant changes in response to different resource availabilities (i.e., ontogenetic plasticity). In general, the quantification of root/leaf plasticity throughout ontogeny showed a marked response to water and nitrogen availability as contrasted with the response to light. Specifically, L. origanoides exhibited more ontogenetic plasticity than L. alba to water and nitrogen availabilities, whereas L. alba showed a superior ontogenetic plasticity to light availability. These results are not consistent with the prediction of the developmentally explicit model. Our results show that the extent of the species*f*?T ecological breadth does not influence the general outcome of the prediction test.

Phenology

THURSDAY JULY 19

Phenology and Habitat Characterization of the Endangered Species Chamaecrista glandulosa var. mirabilis (Leguminoseae: Cesalpiniodea)
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For the last years the anthropological influences to the silica sands of the northern area of Puerto Rico have affected the habitat of many species like Chamaecrista glandulosa var. mirabilis. One of the last populations of this endangered species endemic to Puerto Rico is established at the Laguna Tortuguero Natural Reserve. Therefore, the critical status of this species makes the knowledge of the phenological patterns an important concern for the plant population success and for conservation efforts. The aim of this study was to determine the reproductive phenological stages and habitat characterization of this species. In order to ascertain this, in each visit to the study area, the buds, flowers, and fruits of each plant were counted. Also a climatological station was established and microhabitat climate was recorded. The study revealed a higher production of buds during October and February while the flowering and fruiting production peaked in February and March. Nevertheless, a high production of buds as compared to a lower production of flowers and fruits suggest a poor reproductive success.

Reproductive Phenology of Central Amazonia Pioneer Species in Cecropia¦-dominated Secondary Forests
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The objective of this study was to characterize the flowering and fruiting phenology of the common pioneer tree species that dominate the early successional forests of the Central Amazon. Thirty individuals for each of 13 species were monitored monthly for four years in three different secondary forests, located in the Biological Dynamics of Forest Fragments Project, north of Manaus. Flowering and fruiting were recorded as presence or absence of flower buds, flowers, immature fruits, and mature fruits. Six species showed nearly continous flowering and fruiting throughout the study, indicating that resources were available to pollinators and dispersers on a regular basis. These 13 species comprise over 50% of the individual trees in the secondary forests. The majority of the 13 species produced flowers during the transition from the dry to the rainy season (11 spp) and produced fruit in the rainy season.

Phenological patterns in a tropical Andean cloud forest

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Flowering and fruiting patterns in tropical forest are irregular and complex, mainly because the great diversity of species and biological behaviors that have result from different evolutionary histories. We describe the flowering and fruiting patterns during two consecutive years in a high land forest in Colombia. We evaluated patterns at the community, population and individual level based on (Newstrom et al. 1994). We recorded 507 individuals of 139 species reproductively active. There were monthly reproductively active species but the amount change, with a period of high abundance during the dry season (<100mm/month). Most of the species had supra-annual (39%) and annual (31%) flowering patterns than continual (18%) and subannual ones. At the individual level, supra-annual was also the most frequent pattern (41%) followed by annual pattern (36%). This was also the case at the community level. The number of individuals and species of trees that fructify showed two peaks of productivity throughout the year, however there was only one peak in the total number of fruits produced. There were not clear annual cycles in the fruit biomass or in the number of canopy and understory fruiting species. Similarly, zoochoric and anemochoric species did not show variation. Phenological patterns of high land tropical forests are poorly known and there is not enough comparative information about their cycles. This forest shares some characteristics with some low land tropical forests such as the continual flowering and fruiting, but low land forests have phenological separation among vegetation strata and among dispersal systems. It also have characteristics from temperate forests (e.g.,unimodal annual flowering patterns). Differences found regarding low land tropical forest may be explained due to differences in topography, vegetation structure, abiotic conditions, life history of species and biotic interactions.

Reproductive Phenology, Fruit Biomass and Dispersion Syndromes in two Atlantic Rainforest fragments With Different Conservation Status

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With forest fragmentation, changes in forest structure and microclimate modify the patterns of flowering and fruiting due to plants desiccation and pollinators disappearance. We assessed the reproductive phenology and fruit biomass in two northeastern Atlantic Rainforest fragments, one with 300ha, protected against logging and hunting, and another with 200ha, without protection, expecting to find higher frequency of fruiting and flowering, and fruit biomass in protected fragment. In order to carry out raked-ground fruit surveys two transects (1000 x 1m) were open in the two studied fragments and 200 trees (>10cm DAP) were selected for systematic phenological monitoring. Data were collected monthly during one year (March 2003-February 2004). We found no statistically significant differences in flowering (t= -0,257; p= 0,799) or fruiting (t= 0,901; p= 0,337) between the two fragments, higher fruit biomass in protected fragment (501 kg/ha Vs. 170 kg/ha), and higher rate of fruit production in the protected fragment ((t = 17,4; | t | > t0,05(2)20). We collected 110 fruit species in both fragments. In protected fragment, 88% of collected species were zoochoric and 50% shade-tolerant, against 65% and 24%, respectively, in the non-protected. Even with no differences in the patterns of reproductive phenology, fruit richness and biomass showed that biological

differences may exist between the studied fragments which are subjected to different conservation status. Well-protected areas have higher production and more nutritious fruit (from zoochoric and shade-tolerant species), which indicates better support for frugivores. Even with the absence of mammals and large birds, which is a result of 500 years of habitat loss and hunting, the protected northeast Atlantic rainforest fragments should support a higher diversity of frugivores. We suggest the creation of projects that focus in reintroduction of locally extinct species and programs of local people environmental education, bringing them to help in forest conservation.

Periodicity of radial stem growth in evergreen tropical trees

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A close relationship between phenology and radial growth has been conjectured in tropical and subtropical forest trees. Radial stem growth has been associated with vascular cambium activity. In tropical trees vascular cambium growth may occur either virtually during most of the year, or restricted to a short season. In subtropical environments, seasonal phenology can be observed even in evergreen species. In this study, phenology, and radial growth were analysed in Aphananthe monoica, Pleuranthodendron lindenii and Psychotria costivenia. Leaf initiation and reactivation of the vascular cambium are the most closely related simultaneous events. Several factors can affect stem diameter, the most important of these is likely tissue water content variations, as it may mask cambium activity. Contraction of the stem indicates water loss that it may be quite pronounced during the dry season, but does not surpass real growth.

Plant comunities

THURSDAY JULY 19

Changes in tree and liana communities along a successional gradient in a tropical dry forest in southeastern Brazil

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This study aimed to investigate the changes in composition and structure of tree and liana communities along a successional gradient in a seasonally dry tropical forest (SDTF) in Southeastern Brazil. We selected 6 plots of 50 x 20 m (0.1 ha) at the early (ƒ%^ 5 years since abandonment) and intermediate (ƒ%^ 15 years since abandonment) stages, and 8 plots in the late stage (no record of clear-cutting in the last decades). In these plots, all trees with diameter at breast height (DBH) ƒ%¾ 5 cm were marked and identified, and all lianas ƒ%¾ 2 cm were marked. All plant had their DBH and height measured. We found 1,543 tree individuals, representing 76 species. Species richness increased along the successional gradient, with marked changes in composition and dominance from the early to the other stages. There was an increase in all tree structural traits (DBH, height, stem and species density) from the early to the late stages, as predicted by models of ecological succession. In contrast, liana density decreased from intermediate to late stages, showing a negative correlation with tree density. The same decrease was also observed for liana basal area, probably due to a decrease in light availability as the tree canopy closes in late stages. Patterns in tree community composition and structure were compared to those recorded for other SDTFs in Brazil and the Americas. This is the first study that analyzed changes in liana structure along a successional gradient in SDTFs.

Distribution of pteridophyte community along environmental gradients in Central Amazonia, Brazil.

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In studies of understorey plant community composition, generally a large part of the compositional variation remains unexplained and may be related to environmental variables that have not been measured in the field, such as light availability. Using the pteridophyte community as a model, we investigated the importance of environmental heterogeneity and geographic distance on the spatial distribution. Inventories were done on 38 plots of 250 x 2.5 m distributed over 150 km2 of dense tropical forest. The inclusion of canopy openness increased the predictive power of the environmental model by 9 to 27%, even under the narrow range of 4 to 8.3 % of canopy openness found in our plots. However, there are still a large

amount of unexplained variance (55 to 65%), and this single attempt to improve estimation of community composition suggests that light is not the main factor lacking in previous models. The response of the community to the light gradient was hierarchical, with most species concentrated in low light plots and a few common and abundant species occurring all-over the gradient. Therefore, we could not see evidences of light partitioning along the observed range. Soil properties were the major determinants of community composition, in accordance with most previous studies. However, there was no consistence in the effect of terrain slope on community composition for two close sites. Intensity of mass effects associated with different topographic conditions may be the cause of the observed pattern. Our results do not support the occurrence of dispersal limitation for pteridophytes at the mesoscale (150 km2). Instead, environment was a better predictor of community composition. Although environmental variation determines high turnover of species locally, regional turnover was low.

Lianas are increasing in biomass in a tropical wet forest in Costa Rica

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Lianas are a critical component of tropical forest dynamics, comprising 10-45% of woody plants. Recent studies suggest that lianas may be increasing in abundance, basal area, and productivity, although evidence for these claims remains controversial. We tested the hypothesis that lianas are increasing in abundance and basal area over an eight-year period in a tropical wet forest at La Selva Biological Station in Costa Rica. We censused all freestanding and climbing lianas (ƒ%¾ 0.5 cm in diameter) that were rooted within nine, 24m x 36m permanent plots. In total, we followed the fate of 470 individuals and found that liana basal area increased significantly in this forest (P=0.004 Wilcoxon Sign-Rank Test), but that stem number did not change over the eight-year period (P=0.13 Wilcoxon Sign-Rank Test). These findings support the hypothesis that lianas are increasing in basal area and biomass in neotropical forests, but do not support the hypothesis that liana stem number is increasing. Nevertheless, an increase in liana biomass may result in drastic changes in tropical forest composition and function, as lianas may reduce tree regeneration, growth and reproduction and may ultimately lower whole-forest carbon sequestration.

Mortality patterns in tropical timber trees of the Osa Peninsula, Costa Rica

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The Osa Peninsula, Costa Rica, is a tropical wet forest remanent in the Mesoamerican Pacific Coast. Its vegetation shows a high affinity to the South American flora as well as many local endemism. To study mortality and growth patterns in tree populations of this region, three 4 ha permanent plots were established in 1990. All trees with dbh > 10 cm were marked, and their growth and fate was followed during 15 years. The plots were logged in 1992, when half of the individuals >50 cm dbh of timber species were extracted. In this study, mortality rates of 69 timber tree species from these permanent plots are reported. Natural annual mortality rate was 2% in accordance with previous studies in neotropical forests. Fast growth species showed the greatest annual mortality rates. Logging and strong winds increase annual mortality rates in

these plots, particularly trees of the greatest diametric classes. No significant effect of ƒ?oEl Ninoƒ?? ENSO of 1997-1998 was observed. Using demographic data of this study, extraction of natural fallen wood is proposed and implemented as an alternative source of timber for local habitants.

Is Central Amazon upland forest landscape homogeneous in diversity and floristic composition?

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Considering that the upland forest vegetation in Central Amazon is influenced by soil water availability and thus, by proximity to drainage network, this study was proposed to describe the variation of floristic composition related to topography. The vegetation was divided into three strata according to topographic position: plateau, slope and lowland. The studied area was the Asu Basin located about 80 km north of Manaus, Brazil. This area belongs to INPA (National Institute of Amazonian Research). Over three transects (2.55ha) which were subdivided into 20 by 25m plots, all palm trees, with any DBH, as well as dicotiledons with DBH ƒ%¾ 10cm were recorded. The taxonomic identification was made in field. Importance Value Index (IVI) was calculated for each family. An ordination analysis, Non-metric Multidimensional Scaling (NMS), was applied to identify gradients in vegetation along the toposequence. In the whole floristic inventory, 1514 trees were recorded representing 113 species, 73 genres and 33 families. The floristic composition was diverse showing the Shannon-Wiener indices equal to 3.92, 3.95 and 3.82 for plateau, slope and lowland respectively. The community was divided into two main floristic zones according to NMS. The abundance and composition of plateau and slope species were similar yet significantly different from lowland species. The overlay of species between the plateau and slope was 55% and 40% between plateau and lowland. Fabaceae was the most important family in terms of IVI considering all phytophysionomies. Arecaceae was important only in lowland, signalling the influence of soil water availability to palm trees. Considering all recorded trees, the lowland showed 16% of palm trees, while in the plateau this family represented only 1%. These results showed the stratified sampling is the best way to investigate the upland forest in Central Amazon, since some species are associated with specific topographic and hydrologic conditions.

Geographic reasons for an outstanding vascular plant diversity in southern Ecuador â?"

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The poster presents a scale dependant top-down approach which outlines reasons for an outstanding vascular plant diversity in southern Ecuador using five different levels: ecozone, landscape, mountain, belt, and patch scale. The ecozone scale explains general (paleo-) ecological factors valid for most parts of the humid tropics, among them greater effective evolutionary time, constant input of ƒ?oaccidentalsƒ??, the ƒ?oseasonal variability hypothesisƒ??, the ƒ?ointermediate disturbance hypothesisƒ??, and the impact of soil fertility. The landscape of the Andes in northwestern South America is characterized by many taxa of restricted range which is also true for the discrete phytogeographic transition zone of Amotape-

Huancabamba. On this scale, the confluence of northern and southern elements, habitat fragmentation, geological history, and a high speciation rate due to rapid genetic transiency of some taxa contribute to a high degree of diversification. The mountain scale pronounces the special environmental features of the Cordillera Real and surrounding areas. Various climatic characteristics, the orographic heterogeneity, and the geologic and edaphic conditions are the most prominent triggers for an additional species contribution. On belt scale, prevailing disturbance regimes and stress factors, the orographic situation, as well as the general role of altitudinal climate gradients within the region are taken into account. Finally, the patch scale regards the dependence of alpha-diversity on micro-habitats given by epiphytic niche systems, micro-relief patterns, and micro-successions after small-sized disturbance events

Vegetation structures and ecological features of the upper tree line ecotone in southern Ecuador - an unusual case

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Altitudinal location and structure of the neotropical tree line between Mexico and northern Chile are outlined, showing a special feature for southern Ecuador and northern Peru within the Amotape-Huancabamba floristic zone. Here, the upper timberline is located between 2800 (in some cases 2,600) and 3300 m elevation, although it climbs up to 4000 m north of the Giron-Cuenca Depression and even higher up south of the Huancabamba Depression. The relatively low treeline ecotone in the Cordillera Real of southern Ecuador can be explained by the lack of Polylepis- and Gynoxis-trees. These genera prefer conditions drier than those of the per-humid study area. Ecological research in the Podocarpus National Park implies various types of upper tree line ecotones: Very strong and nearly permanent eastern winds create dwarf forest on ridges (stress). Water logging prevents tree growth above 2800 m on mountain crests with heavy soils (ƒ?olocal timberlineƒ??). On slopes with porous, rocky substrate forests reach their highest distribution up to 3300 m (ƒ?oclimatic timberlineƒ??). Detailed examinations in Cajanuma, at the Paso El Tiro, and on Cerro de Consuelo prove extraordinary species diversity despite very rough living conditions. In Cajanuma twelve tree species could be found on an 800 square meter plot at the tree line - an astonishing number considering that normally only two or three tree species exist in equivalent timberline ecotones in mountains of temperate latitudes. Even more surprising is the high average species number of 205 ñ 12 per 800 square meters.

Distribution and abundance of very large trees in Central Amazonian terra-firme forest

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Very large trees are defined as trees with diameter above buttresses greater than 70 cm because most of the individuals over this size have emergent crowns. These trees account for a large amount of aboveground live biomass, and are home to a myriad of forest life forms. The goal of this study was to assess the diversity, distribution, abundance and mortality of very large trees over a mesoscale of terra-firme forest in Central Amazonia. Trees were measured, mapped and identified in 72 1-ha plots spanning the range of topography and soils gradients in this forest and replicated on a regular design in 64 km2. We also gathered soil data (texture and nutrients) and measured the slope of the ground. The mean density of very large trees was

4.1 trees per hectare (sd= 2.5), ranging from 0 to 11 individuals/ha. Although they have low densities, these trees accounted for 12% of the overall plot biomass (including trees larger than 1 cm dbh). Soil and slope explained around 20% of the variation in very large tree density (F3,68=5.09; P=0.03). Very large trees were more abundant in flat terrain where soils are rich in clay. We identified 295 individuals representing 27 families, 60 genus and 113 species. The ten most common species represent 32% of the individuals. Goupia glabra (Goupiaceae) was the most common tree of this size in the area. Very few individuals of each species where found in 72 1-ha plots indicating that few individuals where able to grow this big. Over a two year interval, annual death rate of very large trees was 1.4% per year, most of which were snapped off. A preliminary analysis suggests that Central Amazonian forests have fewer very large trees than other neotropical forest.

Variation in species richness of selected plant groups along three climatically contrasting elevational gradients in southeastern Veracruz, Mexico

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We studied patterns of species richness of Araceae, Bromeliaceae, Orchidaceae, Piperaceae, and Pteridophyta along three climatically contrasting elevational transects (T1-3) in the volcanic region of Los Tuxtlas in southeastern Veracruz, Mexico. All plant groups have been studied in a total of 74 plots in natural forest, applying a standardized sampling method (sampling effort and area size) and data were analyzed with a special focus on the differences between epiphytic and terrestrial taxa. Along the three transects, a total of about 280 plant species, in 23 families were recorded: 222 at T1, 122 at T2, and 153 at T3. Pteridophyta were the most species-rich group, with about 109 species recorded, followed by orchids (99), bromeliads (26), aroids (24), and piperoids (22). The distribution of species richness per plot showed a monotonic increase followed by roughly constant values at T1 and T2, and a monotonic increase at T3. These patterns were roughly paralleled by all study groups, except for Araceae, which showed a monotonic decrease at T1 and T2, and Araceae and Piperaceae which showed a hump-shaped curve, with low maximum values at about 1200 m at T3. The variation of species richness along all transects is connected to the decline of temperature and the increase of stable water supply with elevation, causing favourable conditions of moderate temperature and high humidity, especially for epiphytes. Thus, apparently macro- and microclimatic conditions affect species richness peaks in distinct ways, not only for life forms (terrestrials vs. epiphytes) but also for the different study groups, reflecting their ecophysiological adaptations.

Richness and abundance of floral resources in two recovering habitats as a preliminary tracking of the community structure and function

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Richness and abundance of floral resources have implications on the presence and activity of floral visitors, and determine the widths and composition diet of floral visitors. Here we made a preliminary comparison of the diversity and abundance of floral resources and floral types

between abandoned and restored pastures of the same age and similar land-use histories, as a way to verify the structural and functional similarities of these habitats. We assumed that floral types represented functional guilds, in which species were grouped according to similarities in floral morphology and kinds of floral resources. We found differences in species composition between abandoned and restored pastures, and although higher richness was registered in restored pastures, curves of rank abundance indicated similarity in the distribution of floral resources per species and per floral types in these habitats. The most abundant species in both areas were in Asteraceae and Euphorbiaceae families, and these species determined the high abundance of small flowers with no constraints to access in floral resources by visitors. Due to the high local variation in abundance of flowers, both kinds of pastures offered an unpredictable environment for floral visitors. The similarities among habitats might be related to the short time since the areas have been managed, and further management input must allow for possibilities of increasing functional diversity as well as provide better chances to find floral resources. (Grant from CAPES)

Diversity and succession dynamics in understory herb communities of lowland rainforests

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Much attention has been directed to the establishment and development of plants in the competitive and resource-limited understory of tropical forests. Most studies however, have focused on woody species, particularly trees, and coincidentally overlooked their herbaceous neighbors. Here, we examined the floristic composition and structure of broad-leafed monocot herb communities in a chronosequence of regenerating and old-growth forests in northeastern Costa Rica. Species richness and percent cover for terrestrial plants belonging to the families Araceae, Costaceae, Cyclanthaceae, Heliconiaceae, Marantaceae, and Zingiberaceae were recorded in six 1-ha permanent monitoring plots. In total, 2,438 herb individuals from 720 sampling quadrats across 3-ha of forests, were identified, mapped, and measured in 2006. Later successional forests boasted the highest number of species whereas earlier successional forests contained the least number of species. Herb cover was significantly lower in earlier successional forests, which is largely due to high irradiance levels and land-use intensity. Of the 39 herb species found, 7 (18%) were only found in old-growth, 6 (15%) in later successional forests, and 3 (8%) in early successional forests. The most dominant family in all stands, including early successional forests, was the Araceae. In contrast, only two species from the Zingiberaceae family were recorded in the entire study.

Origin of patchy vegetation in the coast of the South of Brazil

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The patchy vegetation cover scattered over a matrix of white sand and herbaceous clumps of coastal Brazil is called Restinga. This vegetation is often species rich, although plants are subjected to drought, nutrient-poor sandy substrate, wind, salinity, and high soil and air temperatures. In the restingas, formation of vegetation islands and succession are triggered by the colonization of few pioneer herbs and/or woody plants species, which are able to colonize bare sand and may favor the entry of other species into this community. In the present work, it was aimed to understand the origin of such vegetation patches, by testing the relationship between the perimeter of the patch and plant richness and between the distance to the source area (continuous restinga forest) and plant richness. The study was conducted in a coastal State Park, in the southernmost State of Brazil. As expected, it was found a positive relation between patch size and their plant species richness (Rý = 0,75), but there was no relation between the isolation degree and richness (Rý = 0,14). Considering that plants in this patchy vegetation mostly present vegetative reproduction and depend on nurse plants species, we also tested each patchy community for positive associations.

Arbuscular mycorrhizal fungi dynamics in the tropical dry forest of Nizanda, Oaxaca

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In Mexico, tropical dry forest (SBC) is a community with high values of diversity and endemisms; nevertheless it has been affected in 60% of its original area. It is a priority to carry out studies that estimate the total species richness in order to establish adequate conservation and restoration strategies. Arbuscular mycorrhiza in these communities is very common, fungi that conform it increase the efficiency in nutrient and water uptake in host plants, and rise up their resistance to stress. Nevertheless, the importance of these endophytes in the dynamics of this type of communities is scarcely known, therefore the aim of this work was to make an estimation on the structure of arbuscular mycorrhizal fungi (AMF) community through the analysis of its richness, composition, relative abundance and number of infective propagules, colonization in field roots and density of viable spores in dry and rainy seasons. 12 species are reported, 11 are new reports for SBC in Mexico. Glomaceae family was the best represented one (42%). Number of spores (in 50g dry soil) was higher in the dry season (99ñ38.1) than in the rainy one (59ñ25.6) with a 14% of viability in both, in contrast, the number of infective propagules (in 50g dry soil) was higher in the rainy season (165) than in the dry one (69); nevertheless colonization values in the field 48% (rainy) and 60% (dry) do not reflect dynamics of propagules (spores, hyphae, colonized roots), since colonization is influenced by their availability, as well as by the root growth which depends on presence of water during the rainy season. Changes in the amounts of propagules on time are a response to the requirements of plants during their life cycle, this work suggests that the rainy season should be considered as

the best one for obtaining proper viable inoculum.

Characterization of emerging Spathodea campanulata forests of north-central Puerto Rico
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The African tulip tree Spathodea campanulata Beauv. invades and forms forests in lands previously used for sugar cane, agriculture, and grazing in Puerto Rico and other tropical archipelagos. Alluvial, karst, and volcanic substrates each produce different native forest types within north-central Puerto Rico. On such substrates, we sampled structure and composition of large, small, and understory (ƒ%¾10, ƒ%¾2.5 to <10, and <2.5 cm DBH) trees in nine abandoned sites 25 to 38 years old and dominated by Spathodea campanulata. Forest structure showed no differences across substrates and compared well with native and other secondary forests on similar substrates, although Spathodea campanulata forests have higher basal area. Mean large tree species richness was highest at volcanic and lowest at alluvial sites (10 and 4 species per 80 trees sampled per site), although small and understory tree species richness was similar through substrates. The proportion of introduced species decreased from large to understory trees from 47 to 18 percent throughout sites, and amongst large trees was twice as much at alluvial than at karst or volcanic sites, although it was uniform for small and understory trees through substrates. Mean importance value of Spathodea campanulata was highest at alluvial (91, 74, and 11 percent for large, small, and understory trees) and lowest at volcanic (56, 18, and 1 percent for large, small, and understory trees) sites, and decreased from large to understory trees from 76 to 6 percent throughout sites. Species composition of Spathodea campanulata forests reflect greater human impact on alluvial compared to other substrates in Puerto Rico. Although species richness is lower than that of comparable native forests, it is evident that Spathodea campanulata forests become enriched with species by natural processes and thus serve to restore forest cover, connectivity, and native species on previously deforested, fragmented, used, and abandoned lands.

Fruit-feeding butterflies as indicators of disturbance regime in a Brazilian Atlantic rainforest.
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In this study we investigate the effect of different disturbance regimes on the assemblage of fruit-feeding butterflies (Nymphalidae) in the Brazilian Atlantic rainforest. The study area is located inside a well-preserved vegetation continuum along the Serra do Mar, an important mountain range near the Atlantic Ocean. Sampling was done from November 2004 to May 2005 in two sections with different histories of use inside a reserve, slash-and-burn (SB) and selective logging (SL), both regenerated for at least 18 years. We sampled 709 individuals of 52 species, 22 (182 individuals) in SL and 48 (527 individuals) in SB. There was a significant difference in species richness between the areas, as shown by confidence intervals of the rarefaction curve. The proportional abundance of species was highly skewed to Brassolinae in SL (46.2%) and to Satyrinae in SB (41.2%). Species composition was different between areas,

clearly distinguishing them (NP-Manova, P < 0.001). This study shows that even after almost two decades of forest regeneration, disturbance will still have clear effects on the fruit-feeding butterfly guild, supporting the usefulness of this group as biological indicator of forest disturbance. These results may help in zoning actions inside established or planned reserves in Brazilian Atlantic rainforests.

Microbial communities and soil nutrient availability in a tropical dry forest of Mexico

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We studied season and nutrient availability effects on different soil microbial functional groups in a Mexican tropical dry forest. The study was conducted in three sites with different nutrient availability: tops (rich in C and NH4, but poor in P), slopes (poor in C and P, but rich in NO3) and bottoms (rich in C, N and P) located in neighboring small watersheds. Composite soil samples were taken in three dates during the rainy season and two dates of the dry season, from the top 5 cm in five plots located within each site. Soil total microbes and microbial groups (bacteria, actinomycetes, saprotrophic fungi and arbuscular mycorrhizal fungi) were measured using whole cell fatty-acid (WCFA) lipid biomarkers. We found that all microbial groups decreased from the dry season to the rainy season, as well as available nutrient concentrations. The differences between top and slope sites in the abundance of microbial groups were negligible. The high abundance of total microbes, Gram+ bacteria and actinomycetes in bottoms for some sampling dates suggest that presumably soil P availability rather that C and N availability could be controlling the abundance of these microbial groups in this forests. Also the bacterial/fungi ratio suggests that fungi are more active than bacteria in the dry season, while bacteria dominated during the rainy season. Arbuscular mycorrhizal fungi were higher at the top and the slope than the bottom sites and it decreased from the dry season to the rainy season at the three sites. Our results suggest that soil moisture and likely P availability are important factors for growth of some of microbial groups. However, soil nutrient availability could affect the composition of microbial species rather than the relative abundance of most microbial groups. In turn the composition of microbial species could be influencing soil functional processes.

Diversity of fruit-feeding butterflies in tropical dry forests and homegardens at the buffer zone of Mata Seca State Park (Minas Gerais, Brazil).

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Considering the current state of fragmentation in Brazilian Tropical Dry Forests, bioindicators may be useful to evaluate human pressures in different ecosystems and to define priority actions for biodiversity conservation. The aims of this study were: 1) to compare fruit-feeding butterfly species richness between dry forests and homegardens located at the buffer zone of Mata Seca State Park; and 2) to test the following hypotheses: i) larger homegardens have higher butterfly species richness; ii) homegardens closer to forest patches have higher

richness; and iii) homegardens with higher plant richness have higher butterfly species richness. Fruit-feeding butterfly traps were set up in 20 homegardens, 10 in Maracaia and 10 in Manga-Japore communities, and 20 traps in the nearest forest patch to each community. Measurements of area, distance from forest patch and plant species richness were obtained for each homegarden. A total of 12 fruit-feeding butterfly species were captured. Eunica tatila and Hamadryas februa showed the highest values of frequency and abundance. Dry forest patches had higher butterfly abundance and species richness than homegardens, in spite of the high fruit offer in homegardens. A positive relation between butterfly species richness and homegarden area was observed, but no effects of forest distance and plant species richness were verified. These results indicate that fruit-feeding butterflies are sensitive to habitat quality, given their preference for forest environment rather than human-made environments. However, the species-area relation observed in homegardens may be a promising tool for the elaboration of management plans for buffer zones in conservation units. The utilization of parameters and concepts of island biogeography may be useful to recognize homegardens as isolated agroforestry systems and may also contribute to in situ conservation of non-protected areas of Tropical Dry Forests in Brazil.

Short-term soil microbial community responses to increasing plant diversity in a disturbed tropical humid environment.

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The establishment of woody species in disturbed tropical areas may accelerate secondary succession and increase soil organic matter quantity and quality, which is crucial for microbial activity and nutrient cycling. Our objective was to explore what microbial functional groups respond in the short-term to treatments varying plant diversity and composition. Four pioneer tree species(Cecropia obtusifolia, Erythrina folkersii, Hampea nutricia and Heliocarpus appendiculatus) were propagated and transplanted into a 30 year-old pasture site in Los Tuxtlas,Veracruz, Mexico. Seedlings were introduced in 16 treatments, including zero-, one-, two-, three- and four-species combinations. There were three replicate subplots of each treatment located randomly in the original pasture site. Three years later we took 5 topsoil samples in random points within each subplot to make a composite sample. Whole-cell fatty acid profiles were used to study the largest microbial functional groups, as identified with signature biomarkers for Gram+ and Gram- bacteria, actinomycetes, arbuscular mycorrhizal fungi and saprotrophic fungi. Results showed that, after three years, the microbial soil communities were still very similar in all treatments. The relative content of Gram+ bacteria biomarkers was much higher than the content of Gram- bacteria biomarkers. Most differences were still not significant but some trends began to show. The treatments showing more effect on microbial communities were those including Hampea nutricia, the species that changed more rapidly the microenvironment and had almost eliminated the original grass from the subplots. The biomarker for arbuscular mycorrhizal fungi showed the largest response to plant diversity treatments and was the only biomarker showing, so far, a trend for a positive correlation with increasing plant diversity. We conclude that soil microbial communities are slowly changing to a new composition, mainly in H. nutricia treatments, and that mycorrhizal fungi were the most (short-term) responsive microbial group to plant diversity.

Diversity of endophytic fungi in Bauhinia brevipes (Fabaceae)

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Endophytic fungi colonize internally host plants and protect them against herbivores and pathogens. The aim of this work was to evaluate the richness of endophytic fungi found among unfolded, recently expanded, and old leaves of Bauhinia brevipes (Fabaceae). Ninety leaves were collected from 15 individuals at the EstaCao Ecologica de Pirapitinga, MG, southeastern Brazil. In each individual, two leaves from each age were chosen. The leaves were sterilized, cut in fragments of 5X3 mm from petiole, midrib and leaf lamina of each leaf and transferred to Petri dishes with PDA (potato-dextrose-agar). We found 138 morphospecies of endophytes. The unfolded, recently expanded and old leaves presented 79, 93 e 102 morphospecies, respectively. The similarities (Jaccardƒ?Ts Index) among the leaves of different ages were: 0,509 between unfolded and recently expanded, 0,474 between unfolded and old ones and 0,492 between recently expanded and old ones. Some morphospecies were found only in specific leaf stages. In the unfolded leaves, six exclusive morphospecies were found, in recently expanded leaves, nine exclusive morphospecies were found, and in old leaves, 17 exclusive ones. Especially, Phomopsis sp1 was found in all leaf parts, in all stages and in almost all individuals collected (13 of 15). The increase of endophytic richness with leaf age is probably related to the presence of secondary compounds. Generally, old leaves exhibited fewer substances with antifungal properties and thus suffer a higher fungi infection. The presence of Phomopsis sp1 in all almost individuals studied indicates that this fungus can have strong mutualistic relations with B. brevipes, such as Neotyphodium endophytes from Festuca sp.

Life history approach to allometric scaling and growth
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The density-dependence mechanism is a central topic in modeling population growth. Recently, a general growth model was formulated by de Vladar (2006) that reproduces the logistic, theta-logistic, van Bertalanffy, Gompertz, and Potential growth equations, as well as the equation for ontogenetic growth proposed in the context of the Metabolic Theory of Ecology (Brown et al. 2004). In the latter, it is proposed that a universal exponent theta=3/4 suffices to describe the growth of virtually all organisms. In this research we expect to find out if the theta parameter is either a ƒ?~free parameterƒ?T or a universal invariant as proposed by the Metabolic Theory. To achieve this purpose, we combine de Vladarƒ?Ts general model with life history theory to measure the robustness of this universality assumption. We will re-analyze the data set compiled by West et al. (2001) as well as other data gathered from the literature. Our analysis will make use of maximum likelihood estimations, in order to empirically infer the distribution of the growth and theta parameters. From this distribution we will try to identify patterns corresponding to trade-offs between growth rate and theta, and determine whether it is possible to have and Evolutionarily Stable Strategy (ESS's) leading to invariant values of theta. This

study will provide the base for an additional understanding of the dynamics of populations through the relationship between growth rates and allometry, with resource constraints reflecting the effect of environment over population.

Ecosystem management

THURSDAY JULY 19

Evolution of the activity of leaveâ?Ts gathering of Cryosophila nana in Colima State (Mexico)
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In tropical countries we find a large proportion of the global biodiversity. For its preservation, protection and finding for it possible uses for society are needed. However the use of biological entities requires the development of new technologies that are compatible with ecological, economical and social criteria. Examples of possible systems that comply with all criteria are rare. In this 19-year study we report on a local industry that exploits Chryosophila nana (H.B.K.) Blume (Palmae) for the manufacture of brooms in a tropical dry forest in Colima, Mexico. This species currently appears in the ƒ?ounder risk speciesƒ?? code of the Norma Oficial Mexicana NOM-059-ECOL-2001. We describe the C. nana-broom industry from three survey years: 1988, 1999 and 2007. Through questionnaires and field evaluations of leaf gathering sites, we obtained general demographic data on a sample of families dedicated to this activity in eight Ejidos (eg. scholar status of family members, annual income, age structure), also data on family organization for the broom production process; field site visits were dedicated to study leaf gathering technology. The number of families dedicated to broom production was 65, 59 and 70 in the three survey years respectively. The average level of formal education increased from grade to high school level. However, some individuals already reached college studies. Such changes in scholar education presumably modified the peoplesƒ?T perception of their industry and the preservation status of the palm. Currently average income of members in the broom industry gain 2.5 more than the average agricultural worker.

A chemometrics approach in the environmental assessment of reservoirs in the Lerma river basin (Mexico) using water quality index, algal growth potential and lipid peroxidation
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Water quality is affected by human-induced eutrophication and the toxicity of xenobiotics entering reservoirs that adversely affect their biota. The Lerma river basin is one of the most heavily populated and polluted regions in Mexico. This study examines nine reservoirs surrounded by different land uses in order to analyze their environmental conditions, through three approaches: physicochemcal assessment by water-quality index (WQI), nutrient enrichment by algal growth potential (AGP) and oxidative stress assessment by lipid peroxidation level (LPOX). Water samples were collected from each reservoir to determine physicochemical parameters and estimate a water-quality index. Bioassays were conducted using Ankistrodesmus falcatus and reservoir water to assess the algal growth potential and lipid

peroxidation. Chemometrics analyses such as principal component and discriminant analysis allowed the integration of the three approaches, and clustered the reservoirs along dominant gradients of water quality, algal growth potential and lipid peroxidation, resulting in four groups of reservoirs. The first group is associated to the least polluted conditions, with the highest WQI plus low LPOX and AGP. The second group shares a low WQI plus high LPOX and AGP. The third group has a low LPOX plus moderate WQI and AGP. The fourth group displays moderate WQI and AGP plus a high LPOX. Reservoirs displayed a spectrum of conditions in terms of algal growth potential, level of lipid peroxidation and water-quality index, related to the mixture of compounds entering the reservoirs due to the diversity of land uses within their basins.

Typha Management and Plant Community Response: a Diverse Harvest?

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The cattail Typha domingensis often forms dense monocultures in tropical wetlands, so it has been increasingly labeled invasive even within its native range. We tested the potential of repetitive Typha harvesting (cutting with machetes), an indigenous management practice in Central Mexico, to maintain a diverse plant community. After 1 growing season, 3 harvesting treatments all changed plant community structure relative to a control (ANOSIM R=0.4, p <0.002). Cutting marginally increased non-Typha plant cover in a flooded block, while cutting had no immediate effect on non-Typha cover in a non-flooded block. One economically and ecologically valuable species (Sagittaria latifolia) was present only in cut, flooded plots.

Cutting 1, 2, or 3 times over 1 growing season significantly reduced Typha re-growth, but the 3 cutting treatments did not differ from one another. However, rhizome starch concentrations did decrease with increased cutting repetition (p=0.06). A regression tree explained 80% of the variance of Typha vigor (in August), but pre-cut Typha vigor (in May) explained more variance than did cutting treatment. In areas where Typha was initially less dominant, cutting actually increased Typha vigor (p < .01). Also, Typha*ƒ*?Ts regrowth strategy (new ramet production versus re-growth from existing ramets) changed with hydroperiod and cutting frequency, with potential impacts on canopy structure. Though continencies such as hydroperiod, frequency of cutting, and spatial location appear to influence the outcomes of this management, intensive Typha harvesting appears beneficial for maintaining a diverse plant community.

Effect of forest fires and agriculture on forest structure in two sites at the Lacandona Rainforest, Chiapas.

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We evaluated tree composition and structure in two ejidos with different history of disturbance in the Lacandon Rainforest, in Chiapas, Mexico. One of the sites (Corona) was strongly affected by forest fires in 1998, while the other site (Reforma Agraria) has been historically more affected by slash and burn agriculture. We established a total of 94 circular plots of 1000 m2 (44 in Corona, 50 in Reforma Agraria) in which we identified and mesasured DBH and

height in all trees DBH ƒ%¾ 10 cm. Plots were randomly located on disturbed and undisturbed forest. We estimated tree basal area, volume and biomass. We also constructed dominance-diversity curves. Finally, we conducted an NMS ordination analysis to evaluate the degree of aggregation of plots with different histories of disturbance. Mature forests in Reforma Agraria had the highest tree volumes, basal areas, biomass, and tree diversity. Plots that experienced forest fires were separated from plots that experienced agriculture, and were more similar to mature forest plots. Our results support the notion that agriculture drastically affects forest structure and composition beyond the effects of burning.

Effects of land use on fishes of the upper watershed La Antigua, Veracruz, Mexico
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Fish respond to changes in abiotic and biotic factors, such as habitat and water quality, indicating that some environmental parameters are outside of their tolerance limit. With the objective to evaluate the influence of land use on the hydrology and resident fishes to upper watershed, a study was conducted at 10 sites in Veracruz, Mexico with three different levels of disturbance: pasture land, coffee plantation and reed bed. Five samples were taken in second and fourth order streams, from August 2005 to March 2007, sampling the ictiofauna, morphometric variables of the streams and physical and chemical parameters of the water. The analysis of the water quality of streams within pasture lands had low levels of nutrient quantity, whereas streams within coffee plantations had high quantity of organic matter. A total of 2176 fishes were captured, representing 8 families, 13 genera and 15 species. The specific richness ranged from 1 specie in the uplands region to 13 species in the lowlands of the watershed. The specie Heterandria bimaculata had the greatest abundance (61%) and distribution range (100%). Analysis of H. bimaculata populations, showed that significant differences existed ($P < 0.05$), with the populations from coffee plantations with greater weight and length values, as well as evidence of parasites and deformity. In contrast, the reed bed population had significantly lower weight and length values; while the pasture lands were intermediate. In conclusion, there significant differences were found between the weight and length values of H. bimaculata populations in relation to the environmental characteristics of the region where they were collected. The analysis of others demographic attributes such as: litter size, embryo weight and reproductive effort of these fishes can confirm the results obtained in this research.

Species-specific characteristics that influence tree health in the eastern Brazilian Amazon
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Tree health affects the maintenance of forest processes and the economy of forest management. In Amazon, trees rejected due to stem damage are either not felled or abandoned in the forest, increasing the amount of coarse wood debris, fuel loads and fire intensities. Management practices that deal with damaged or defective standing trees are critical in Amazonia, where timber extraction without management plans are among the most common land uses. Because tree defenses against damage vary within and across species, species-specific characteristics must be considered in any proposed strategy. I investigated if the variables tree dimension (as a function of DBH), average wood specific gravity and growth

rates influenced the occurrence of stem damage in a 100 ha plot in a certified forest in the eastern Brazilian Amazon. Wood specific gravity and growth rates were estimated at species-level based on the literature. Seventeen of 51 tree species were represented by more than 30 individuals. Approximately 3.6% of them and 3.5% of the total 1908 trees higher than 35 cm DBH presented cavities in the stems. Mean percentages of damaged trees among the most abundant species ranged 0 ƒ?" 12.62 (mean 2.5 +/- 0.97 SE). These trees represented 12.62, 11.94 and 11.76% of the total number of individuals of the important timber species Manilkara dentata, M. huberi and Copaifera duckei respectively. Tree dimensions were positively related to the occurrence of external stem damages (Rho-squared = 0.12; p < 0.000) when all species were considered, but effects varied across species. Average wood specific gravity and growth rates per species had no significant effect on tree health (R-squared = 0.113; p = 0.432). DBH was the only variable that influenced tree health. Data for individual trees are required for more accurate analyses. Environmental factors that influence tree health will be subsequently investigated.

Annual rings provide evidence of ages of secondary forest patches

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The number of studies on secondary forest succession has strongly increased in the last decennia due to enforced interest in restoring forest cover in deforested landscapes. Such studies often use chronosequences of forest patches of varying ages to estimate forest recovery rates in terms of biomass and diversity. Those studies necessarily relied on information of landowners to determine patch ages, which may lead to large errors. The occurrence of annual tree rings in species that appear immediately after abandonment could greatly help to overcome such errors by providing reliable and independent age determinations. Also, tree rings can prove useful in reconstructing stand dynamics and speciesï succession.
In this study we examine the occurrence of tree rings in 70 pioneer and early-successional species in two different areas in Mexico, a dry area in the state of Oaxaca and a wet area in Chiapas. Discs or increment cores of more than 450 trees were collected from patches of different ages (3-36 years).
First results indicate that a relatively large percentage of species in both areas (65% for dry area and 57% for wet area) show distinct growth boundaries, but we also observed (incomplete) intra-annual bands and/or wedging rings, which impedes the use of complete stem discs in those species. Comparison of patch ages with the number of rings confirms that rings are mostly formed annual and that several typical neotropical pioneer species have a good potential to provide independent evidence of patch ages. In some instances the number of rings of early pioneers deviated significantly from patch ages, which is probably due to incorrect information provided by landowners and/or delayed succession after abandonment.

Microbiosphere: Scientific Ecoturism for the sustainable development in the

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The Nanciyaga Ecological Reserve is a Conservation unit of Sustainable Management of the Wild Life located in the influence zone of the Tuxtlas Biosphere Reserve in the northwest shore of the Catemaco Lake, it has 44 hectares of extension of high perennifolia forest.

The relation of the man with the nature has been mainly utilitarian since the economy of the humanity rests in diverse environmental services that without planning hit negatively to the ecosystem. Nevertheless, the economic activity of the scientific ecoturism offers the possibility of using these services without exhausting them.

Microbiosphere operates under the new concept of microecoturism, that is a branch of the scientific ecoturism; understanding like the assembly of activities that the people make to discover, enjoy and know the members of the microworld as well as its biological, ecological and economical importance. Besides, it will foment the respect and the conscience of the necessity of the natural resources sustainable management.

Crusta S.A. de C.V. and the Metropolitan Autonomus University Campus Xochimilco, keeping in mind the need of conserve the tropical environments present the project of scientific microecoturism: Microbiosphere Nanciyaga Unit, will wich affect the ecological conscience of an average of 150 thousand tourists per year, who will observe by microscope the diversity of aquatic species of some taxonomic groups like rotifers, copepods, cladocerans, among others, and some structures and textures of organisms of greater size like endemic fish, crustaceans and mollusks.

In this context, we present the advances of the project processed under agreement of scientific collaboration of the Laboratory of Rotiferology and Molecular Biology of Plancton and the Crustaïs Company with the support of the socially responsible companies that have been gotten up to the project in answer to foment the sustainable rural development in tropical environments.

Integration of ecological, social, and economic factors in the analysis of the regulatory process of Heart of Palm Extraction from Geonoma edulis (Arecaceae)

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The illegal extraction of palms to harvest ƒ?~heart of palmƒ?T is a common problem that affects many species in Central and South America. This research focuses on Geonoma edulis, known in Costa Rica as Surtuba. The market for the palm is present year round, but peaks during the catholic celebration of Easter. The objective of this research is to analyze the social and ecological context of the illegal extraction of this species to provide sound social, cultural,

economic and ecological alternatives to balance conservation needs with the cultural requirements of human populations. We conducted 40 interviews on patterns of use and preference of Geonoma edulis in Cariblanco, Heredia, Costa Rica, to determine the extent of the black market. We also conducted general interviews with the Ministry of the Environment (MINAE) to analyze the effectiveness of law enforcement. We found a sizeable black market for G. edulis, which the current laws are not able to regulate. Interviews showed that extraction centers on Easter, and that traditional values trump current laws. From MINAE records it was found that even with increased patrols, the number of confiscated palms has not gone up. Officials from MINAE admitted that there are not adequate personnel or budget to tackle this problem. The future of this issue, stated by MINAE officials, is collaboration between rural communities and MINAE officials, as well as the implementation of education programs to enlighten future generations in hopes of stopping illegal extraction. Until strong programs based on education to build trust between communities and MINAE are started this problem will not stop. The demand will not cease unless the laws are actually enforced, or alternative approaches are attempted, such as the commercial production of heart of palm, sustainable extraction using certification programs, or the use of private controlled extraction sites.

Phytoplankton and zooplancton production Laboratory for fish, mollusks and endemic crustaceans feeding of the Catemaco Lake, Veracruz (Mexico).

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The volcanic origin of Catemaco Lake, allows a high degree of endemism, for example: the snail ƒ?otegogoloƒ?? Pomacea patula catemacensis, the crustaceans Procambarus vazquezae and Procambarus acanthophorus, the fishes as ƒ?otopoteƒ?? Dorosoma petenese and Poecilia catemaconis, the ƒ?oguatopote blancoƒ?? Poeciliopsis catemaco, the ƒ?opepesca de catemacoƒ?? Bramocharax caballerol and the ƒ?oespada de catemacoƒ?? Xiphophorus milleri and Xiphophorus clerenciae, catalogued like species in danger, as well as ƒ?oguayacon olmecaƒ?? Priapella olmecae registered like threatened species.

The main cause of the native species risk status, is the high density of fishermen (26 fishermen /ha), represented by 1042 fishermen, 219 boats and 1832 arts of fishing, creating the necessity to make a sustainable handling of those resources.

In this work, we present the methodologic design for the alive food production laboratory whose main function is the isolation, maintenance and culture of native stocks of phytoplankton and zooplancton species, that serves like food during the critical phase of production; that is, the first stages of development of the different species. This laboratory is an strategy of handling for the Repoblacion and Native Species Conservation Program that is made in the facilities of the Ecological Reserve of Nanciyaga.

Understory diversity and structure under Pinus pseudostrobus plantations in Nuevo San Juan Parangaricutiro, Michoacán, Mexico

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Forest plantations foster the establishment of native species in disturbed sites in the tropics. However, this process has been scarcely studied in coniferous forests in tropical latitudes. Moreover, little has been done to experimentally evaluate forest practices that might simultaneously enhance the integrity of the ecosystem and the growth of trees in plantations. In Mexico, 98 % of all timber and non timber production comes from these ecosystems, where plantations of native species are ever more frequent. In this study we evaluated the effects of cattle exclusion and enrichment with the nitrogen fixing shrub Lupinus elegans on the structure and composition of the understory beneath Pinus pseudostrobus plantations in Nuevo San Juan Parangaricutiro, Mexico. In 12 plantations of three different ages (5, 10 and 15 years, four plantations per age), we established an experimental plot in which three contiguous 15 x 15 m subplots were each assigned a treatment: cattle exclusion and L. elegans enrichment, cattle exclusion, and a control with no treatment. Understory structure and composition was recorded in five 2 x 2 m squares within each subplot every three months for an 18 month period. We found that species density and density of individuals was higher in the understory of 10 and 15 year old plantations than in 5 year old plantations, and that both variables reached a peak at the beginning of the rainy season. Height of individuals and number of leafs per individual showed the same trend. However, experimental treatments had no effect on any of those variables. Plantations of native P. pseudostrobus maintain a high diversity in the forest understory, but cattle exclusion and enrichment with L. elegans do not affect understory structure and composition.

Current and potencial use of Seasonally Dry Tropical Forest in Chamela, Mexico

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The Seasonally dry tropical forest around Chamela biological station in Mexico has been drastically affected by land use change. One alternative to reduce the lost of species associated with the transformation of forests to livestock fields, would be to promote forest management, particularly of non-timber forest products with a current market value. In this study we documented the potential uses of native plants of the region of Chamela in two steps. First, for all species documented in primary forests at the biological station, we looked in the scientific literature and local reports for potential uses. Then, we conducted open interviews with farmers of two villages adjacent to the reserve, to evaluate their knowledge on the uses of the local flora, and their interest to use local plants. Of 1149 vascular plant species reported for Chamela, we found reports of uses for 501 (43.6 %). Herbs are the plants that have the higher frequency of use, followed by trees. More plants were had reports of use as medicines than any other use. Farmers of both villages around the station settled less than 40 years ago. They reported very low numbers of useful species, and reported little interest in doing other economic activity other than livestock production. Most of them, however, reported having

interest in using native plants that might be useful in livestock production.

Effect of Bursera simaruba stakes and the cutting of Pteridium aquilinum on seed rain and seedling establishment in the Yucatan Peninsula

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Succession of tropical forests following natural or anthropogenic disturbances can be inhibited or halted by the establishment of monodominant herbaceous species. In the Yucatan Peninsula, one such species is Pteridium aquilinum, which creates dense patches in which other species fail to establish. In 2001, stakes of Bursera simaruba were planted in five patches dominated with Pteridium aquilinum in the North of the Yucatan Peninsula, to evaluate if the shading effect of their crown reduced the vigor of P. aquilinum. Here we report a follow up experiment in which we evaluated whether established B. simaruba individuals increased zoochorous seed rain, as reported in other sites. In addition, we evaluated whether seedling establishment increased next to B. simaruba individuals. We complemented this last experiment by evaluating whether cutting of P. aquilinum increased seedling establishment. In each of the five original experimental plots we selected five B. simaruba individuals, ensuring that their crowns were separated as not to affect one another. Under each B. simaruba we placed two circular 0.25 m2 seed traps. We also established two 1 m2 squares, in one of which we cut all P. aquilinum fronds each month. A similar set up was established at five random points in the same P. aquilinum sites, away from the influence of B. simaruba. Zoochorous seed rain changed along the year, but was not affected by B. simaruba. The number of established seedlings and the density of established seedling species increased with cutting of P. aquilinum fronds, but was not affected by B. simaruba. Our results suggest that in our site B. simaruba individuals are not serving as foci to increase the dispersion of zoochorous seeds, and that fronds of P. aquilinum is indeed arresting succession.

Biological control of Haematobia irritans (L.) in Colima, Mexico, using local strains of entomopathogenic fungi (Hyphomycetes).

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Haematobia irritans (L.) (Diptera: Muscidae), the horn fly, affects cattle production in Colima, Mexico. Usually this pest is controlled with synthetic pesticides, however several populations are now resistant to many of these chemicals. In this project we evaluated eight local strains of Metarhizium anisopliae Metsch. Sor. and Paecilomyces fumosoroseus (Wize), Brown and Smith, as potential candidates to control the populations H. irritans. In parallel we studied the fluctuation of various fly populations in Colima, throughout five cattle ranches in 2003-2004. Under farm conditions we examined in total five isolates of M. anisopliae and three of P. fumosoroseus. Horn fly individuals were observed constantly in all months and ranches, fly density per cow ranged from 5 to 504 flies/cow. Fly population peaks were associated to

seasonal weather condition changes, particularly ambient temperature and relative humidity. Three M. anisopliae strains reduced the H. irritans populations to 0-5% size after 10 days of treatment. The remaining five strains also promoted a significant reduction of fly density after 12 days of treatment. All strains appear to be potentially useful as biological control agents of the horn fly.

Provision of ecosystem service of infiltration in the basin of the Rio Cuitzmala in México.
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Within the framework of the long*ƒ*?"term ecosystem research regarding the tropical dry forests that is being conducted by the UNAM in the Southwest of the State of Jalisco, Mexico and following the ecosystems*ƒ*?T management approach, a general survey was made in the basin of the Cuitzmala River related to the capability of a series of landscape units to provide ecosystem services of infiltration and deep infiltration.

The mentioned estimate was carried out by means of expert choice and spatial multi-criteria analysis methodologies, taking into consideration the permeability of rock material and of the soil, the annual precipitation and the annual evapotranspiration, the vegetation cover, as well as the calculation of the hydrologic flow direction and flow accumulation derived from the basin*ƒ*?Ts Digital Elevation Model.

The landscape units with the highest relative values (between 75 and 100 per cent) regarding their capability of providing the ecosystem services of infiltration (at the superficial and sub*ƒ*?"superficial level), conjointly occupy approximately 34% of the basin area, whereas for the case of deep infiltration, the units with highest capability of rendering the mentioned services only occupy around 1.16% of the basin surface.

The existence of these ecosystem services contributes to the recharge and discharge of water over the entire length of the basin, which is of fundamental importance in the dry season, in order to meet the basic requirements of inhabitants and of their productive activities, whereas during the rainy season, these are areas that contribute to the mitigation of extreme events such as floods. Therefore, the relevance is evident of the conservation and restoration of the conditions that make it possible to provide infiltration services in those landscape units of the basin that are the most vulnerable to deterioration and degradation.

Human development and tropical ecosystem

THURSDAY JULY 19

Tropical Ecology Group of the British Ecological Society
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The aim of the Tropical Ecology Group is to promote and facilitate communication and interaction between tropical ecology researchers in the UK and abroad. Activities include symposia, workshops and training sessions. We will gladly advertise studentships, recruitment opportunities, courses, funding and potential field sites on our website (www.besteg.org). Please contact us for more information or to join the mailing list.

Synergistic effects of roads and hurricane Emily on an insular tropical forest
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Hurricanes are the most frequent and important natural disturbance in Caribbean forests. Forest edges are vulnerable to wind damage and high light incidence. In July 2005, hurricane Emily (Level 4 in the Saffir-Simpson Scale) hit Cozumel Island, Mexico, with winds up to 260 km/h. We evaluated the mechanical damage on trees caused by the combined effects of roads and hurricane Emily. Our study site, in the central portion of the island, is covered by semi-evergreen forest and is crisscrossed by a network of 3-m wide gravel roads arranged in a grid similar to a fish bone. Roads with such shape expose the vegetation to one (linear edge) or two edges (corner, angular edge). In each of six (500 m x 600 m) plots, we estimated the mechanical damage to trees (bent, fallen dead, broken, uprooted, and with no damage) at three distance categories (0-10, 25-50, and 100-250 m) from linear and angular edges. After Emily, the forest was 100% defoliated throughout. We found that 602 trees (33%) of a total of 1867 were damaged. Bent trees were the most common type of damage (73%) in both kinds of edges and at different distances from the edge with more bent trees at corner edges. The second most frequent tree damage type was broken trees (18%), followed by fallen dead trees (6%) and uprooted trees (3%). Trees near the edges were smaller (height and diametric size) than those at the forest interior and therefore were more likely of being bent; whereas larger trees at forest interiors were more likely of being broken. In general, results show that the effects of hurricane Emily on the tree community of Cozumel Island were magnified by the road creation. Wider roads or forest openings would probably worsen these synergistic effects, increasing the vulnerability of the island.

Management regime, soil and vegetation degradation and social perceptions on degradation and restoration at a tropical dry forest of the Pacific Coast of Mexico
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Peasants manage ecosystems to obtain food derived from the agriculture or cattle raising. This management can drive to the degradation of the ecosystem when changes in soil and vegetation conditions prevent the provision of multiple services. In the tropical dry forest around the Chamela-Cuixmala Reserve there is a mosaic of plots converted to pasture, abandoned land and forest fragments in different degradation conditions. We documented management history, soil and vegetation degradation condition, and related them to stakeholders*ƒ*?T perceptions on degradation and restoration. Surveys were made in five towns to describe magnitude, frequency and intensity of the management practices in 30 plots with contrasting management histories; we established one 50 X 20 m transect per plot to census all woody individual, and all herbaceous individuals within a 1 m2 subplot; we excavated one soil profile to evaluate edafo-ecological parameters. Practices related to the magnitude and duration of cattle raising were the most contrasting among sites. The first horizon, the porous space and the aeration capacity of the soil were most affected by cattle raising. An increase in the abundance of leguminous species was found in fallow fields.. Seventy percent of the interviewed peasants identified changes in vegetation structure and 30% changes in soil physical attributes; nevertheless they did not attribute them to management but rather to water shortage. Perceptions on restoration were mostly related to water scarcity, and illegal resource extraction; 90% of interviewees want their plot to continue producing, 70% of them cattle raising is hard to maintain, , but 90% agree with present management in the region. Future recommendations include reducing burning and decreased impact of cattle raising.

iACG: A Site-Based, Decentralized Approach to Promoting the Quantity, Quality, and Relevance of Research in a Conserved Tropical Wildland

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Investigadores ACG (iACG) is a volunteer, non-profit organization to promote research in the Area de Conservacion Guanacaste (ACG), Costa Rica. In 2006, we proposed iACG as an internet-based organization to facilitate the exchange of information and the pooling of accumulated knowledge among researchers and the larger community of ACG administrators and users. iACG is now building as a consortium of investigators loosely organized around a central web-resource (http://www.investigadoresacg.org) comprised of two main components: (1) communications tools that allow investigators to communicate effectively with one another and the larger ACG community and (2) storage and organizational tools which make available commonly useful data.

Although numerous taxon and topic specific databases now exist for tropical biodiversity, a site-based approach can be an important complement to these initiatives. First, it provides a repository for the secondary products of biological research (natural history observations, maps, photographs) that have few outlets for publication in today*ƒ*?Ts primary literature, but together make up important documentation of the wild biodiversity of a particular site. Second, it encourages linkage of biological field research to the information needs of local biodiversity managers. Third, it places this information in a single site where it can be available to the entire community of users of the tropical wildland: managers, other researchers,

educators, or biodiversity entrepreneurs.

Using the Wikimedia foundation as an example, iACG will utilize emerging web technologies to compile information in a decentralized and collaborative way. Remaining challenges are how to create incentives for researcher participation and how to structure iACG to minimize the bureaucratic load already borne by the staff of the ACG. In this sense iACG is also an experiment: can a web-based community be created out of an international group of investigators with diverse goals and interests, and if so, what will that community produce?

Resilience of a socio-ecological system: adaptability of local institutions for managing biodiversity in a protected area in the northeastern Yucatan Peninsula

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A resilient system is that which adapts to external perturbations without losing its controls on function and structure, its capacity to self-organize and the ability to learn and adapt. Under certain circumstances, socioecological systems in the Tropics, often composed by local communities managing common property resources, seem to be resilient due to a set of institutions (rules for organizing activities) that allows them to adapt to continuous perturbations. We analyze how local institutions have managed resources for the past 40 years in the Otoch Ma'ax yetel Kooh protected area in the northeastern Yucatan peninsula, Mexico. Traditionally, Yucatec Maya inhabitants manage natural resources based on shared ecological knowledge and promoting the diversification of activities (maximizing available options instead of maximizing yields). We explore the way in which these local institutions have dealt with different kind of perturbations: from government programs of regional development (agroforestry, agriculture and tourism), to the declaration of the site as a protected area. We use participatory observation, semi-structured interviews and survey data to identify the rules by which the management of resources has been regulated over time, how conflicts have been resolved, and how activities have been incorporated into or excluded from the strategy of resource management. We also analyze the role that different external agents have played in the development of the area and how local institutions have been shaped by them. Our study shows that while some local institutions have been able to adapt to disturbances, development programs that promote specialization and short-term monetary income (e.g., from tourism) threatens with eroding traditional ecological knowledge and the diversity of resource management strategies, thereby affecting the resilience of the socioecological system.

Advancing Conservation Biology Education in the Tropics: the Network of Conservation Educators and Practitioners

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In many countries in the tropics, limited access to educational and training resources is one of the greatest obstacles to building capacity in biodiversity conservation. To address this issue, the Center for Biodiversity and Conservation of the American Museum of Natural History and its partners have developed the Network of Conservation Educators and Practitioners (NCEP, http://ncep.amnh.org). NCEP is currently active in a number of countries, including Bolivia, Laos, Madagascar, Mexico, Peru, Rwanda, United States, and Vietnam. The project rests on two straightforward ideas: increasing university professors and conservation trainersƒ?T access to high-quality instructional materials, and fostering an active approach to teaching and learning that attempts to model the realities of conservation practice. To meet these goals, NCEP develops and freely disseminates a series of multi-component teaching modules in several languages (English, French, Laotian, Spanish), and runs local professional development workshops for educators. At present, more than 60 complete or partial modules are available, and since 2001, NCEP has run 43 workshops and training events in ten countries for more than 1,000 university faculty members, conservation practitioners, and students. Evaluations of efforts to date in Bolivia and Laos indicate that module usage continues to increase, that the modulesovide up-to-date information on relevant topics, are easily modified to meet teaching needs, include multi-disciplinary and global perspectives, and increase active learning. Results to date point to several challenges, such as how to encourage collaborations among module authors of diverse backgrounds, as well as lessons, including the importance of pursuing strategic in-country partnerships that promote synergy among different capacity-building strategies. We highlight the importance of efforts that allow the development of teaching resources and skills to be complemented by efforts targeting in-service training for conservation professionals and the development and strengthening of conservation biology academic programs in tropical countries.

Socio-environmental characterization of the vegetative regeneration managment of Quercus castanea Nee for fuelwood

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The management was characterized and evaluated the vegetative regeneration of Quercus castanea, a oak preferred for firewood, in a community of Patzcuaro, Michoacan. The characterization was divided in two axes. The social one, was studied whit interviews, explored the factors that determine the management of species and the perception of vegetative regeneration. The environmental axis, was evaluated using closest individual method (n=250 oaks whit basal circumference ƒ%¾10 cm), for Q. castanea individuals was registered: number of cut events, number of sprouts, basal diameter and diameter of cut. The age of sprouts was estimated counting rings of growth of those of greater diameter (n=24), assuming that would be contemporary whit those that arisen from the same cut event. Vegetative regeneration was evaluated on the basis of the collected data of the characterization of the management.
The main reasons for which the informants visit the extraction sites of firewood are the proximity: to ways, parcela and house. The informants recognize: the capacity to sprout like an intrinsic characteristic of the oaks and like important factors that affect the sprouting, growth and survival of them the humidity (edaphic and atmospheric), the characteristics of the cut, the age and the diameter of the tree. The number of cut events increases the probability of an individual to be approaching of again and those with greater basal area have a greater number

of cut events. Due to the great variation of diameters of the contemporary sprouts, single the estimation could be done of the time of approaching for the sprouts of greater diameter for each event of cut. The informants underestimate the time of growth of the sprouts. The alometric equations were obtained to consider the total basal area of the sprouts and diameter of the sprouts of greater size.

History and use of the tropical dry forest of the ejido of huautla, Morelos, Mexico.
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The current situation of the ecosystems in our country should be seen from an environmental historic perspective that include the natural resources tenure and appropriation. Because the human being maintains a very narrow relation with the ecosystems changing and transforming them through the use and exploitation of the natural resources and their appropriation is related with the ground tenure. This work is interested on the evaluation of the historic changes and the influence that has had the type of property in the use of the natural resources to understand the present state of the Biosphere reserve Sierra de Huautla (REBIOSH) which is found south of the state of Morelos, Mexico. This job wants to know which is the state of tropical dry forest (TDF) inside the ejido of Huautla that is the main human settlement in the REBIOSH, taking into account the history of the land tenure and the use and appropriation of the firewood resource. We try to apply a holistic, hierarchical, inclusive and relational method that take into account its biotic, abiotic and social components. We present the historic reconstruction of the land tenure from the revolutionary time to day, as well the exploitation of the firewood resource and of the most utilized trees species. The ejido of Huautla was physically characterized using the basin and landscape perspective identifying the abiotic factors that influence the characteristics and distribution of the TDF. We carry out nine sampling of vegetation to know the present state of the TDF studying its structure and composition.

Science Outreach for Students: Initiatives to connect local schools to ecology
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New College of Florida has developed a regional outreach and mentoring program appropriately titled SOS (Science Outreach for Students) to link college students with K-12 students. This award-winning outreach program aims to enhance K-12 education and transform the public's awareness and understanding of environmental science and ecology. This goal is achieved by connecting communities and schools to the enthusiasm for and knowledge of science abundantly available in their local universities. Since its inception in 2004, over 6,000 people have received science education through outreach by SOS participants. SOS not only impacts the community, it also changes the outlook of many of its participating science students. Over sixty undergraduate students taught science in K-12 classrooms, and many of these students were inspired to consider careers in science education. We present this model

as an opportunity for other college campuses to utilize our methodology and replicate this program elsewhere. We are creating educational units to disseminate to other college campuses, through a web site (www.treefoundation.org) and also through the publication of middle school hands-on science curricula notebooks using activities successfully piloted at local schools. It is our hope that this science education model of youth teaching youth can be replicated on college campuses throughout the country.

An ecosystem service approach to coffee production in a landscape

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Native forest fragments contribute substantially to the productivity and quality of coffee plantations, and improve the economic returns derived from them by providing pollination and pest control services. However, in the mosaic landscape of Kodagu, India, coffee is traditionally grown under shade trees, so the landscape offers an almost continuous tree cover connecting forest patches. In addition, a dense river and road network increases the amount of edges acting as habitats and food resources for insects. Quantifying the ecological and economic contribution of the full landscape to coffee crop provides the basis for an integrated management of the landscape. In this context I am investigating (i) the pollination and pest control services provided by different landscape elements to coffee plantations, (ii) the factors affecting the quality of these ecosystem services, in particular the size, isolation and complexity of each landscape component, as well as the integrity of the landscape, and (iii) the economic values derived by farmers from the pollination and pest control services and how they vary in response to landscape characteristics. I will then develop a model describing pollination and pest control services in ecological and economic terms to support decision making in this community.

Macroinvertebrate communities as soil health indicators in livestock production systems derived from low deciduous tropical forest

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Soil macrofauna is considered a valuable indicator of soil health, allowing monitoring of soil sustainability, because of its high sensitivity to disturbance; however little information about this topic is available. We studied soil macrofauna communities in low deciduos forest and livestock production systems constituting a management gradient in order to describe community structure across systems, evaluate sensitivity of taxonomical groups to management-derived disturbance, and detect sensitive biological groups with potential use as biological indicators of soil health or early indicators of soil degradation. Pitfall traps and monoliths were collected at each of five agroecosystems (forest and livestock production systems with increasing management time and intensity) to sample macroinvertebrates and to estimate their taxonomical abundance, biomass, richness, diversity, evenness, dominance and response to

disturbance across agroecosystems. Agroecosystem TP2 (two-year old Taiwan-grass) had the highest macroinvertebrate abundances, biomass and richness, low diversity, and a non-homogeneous distribution of individuals among species; in contrast, SP (silvopastoral system), had low abundance and biomass, the lowest specific richness, high diversity and an homogeneous distribution of individuals among species. At the discriminant analysis used to validate the management gradient of agroecosystems, 68% of macroinvertebrate species and 62% of earthworms show a correct assignation to agroecosystems (66.23 and 42.18% of explained variance), and SP soils separated form the rest (distinct macrofauna patterns). Coleoptera had an opportunistic behavior, becoming dominant as disturbance increased, Hymenoptera showed a temporal pattern, with peak dominance at systems with intermediate disturbance and decrease in dominance at SP; Orthoptera and Arachnida showed susceptibility to disturbance (the first with highest abundances at forest and TP2, the second more elastically). Earthworms had different responses to disturbance, depending if the species were native or imported. Arachnida, Orthoptera, Coleoptera and a new Ocnerodrilidae earthworm species are suggested as soil health indicators for managed systems derived from dry lowland forests.

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