

gtö 2014 Tropical Ecosystems – Between Protection and Production Freising, February 25-28, 2014

# TROPICAL ECOSYSTEMS – BETWEEN PROTECTION AND PRODUCTION

Conference of the Society for Tropical Ecology  
Freising, February 25-28, 2014



## PROGRAMME & ABSTRACTS



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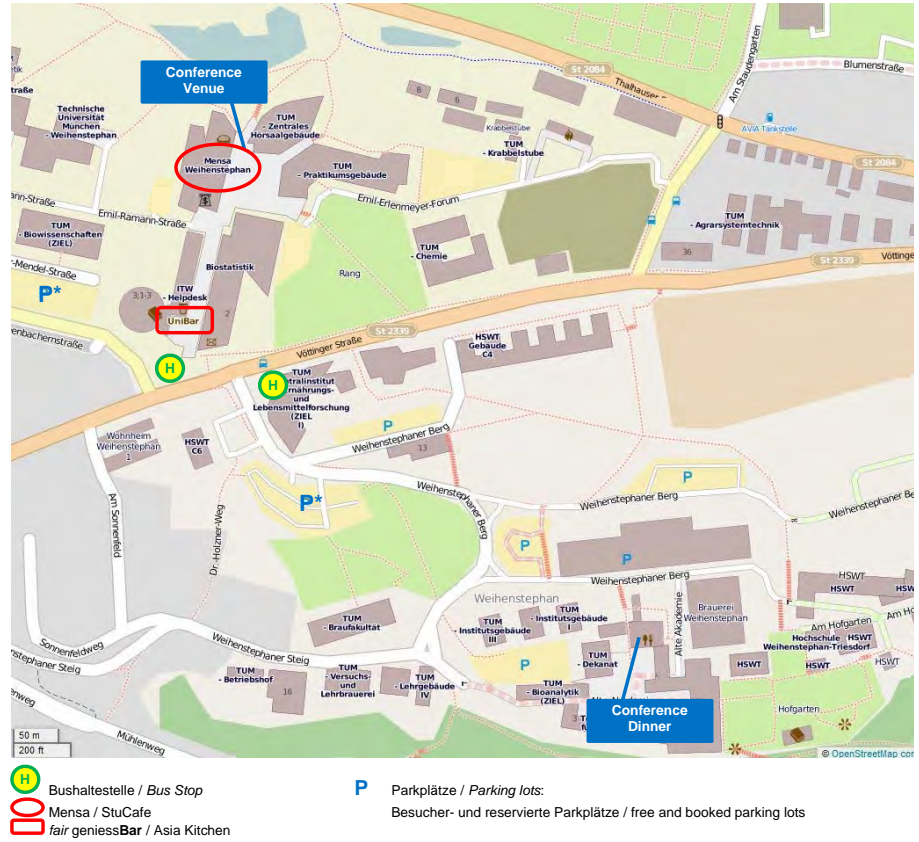
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# gtö

Gesellschaft für Tropenökologie e.V.  
Society for Tropical Ecology



Time	TUE 25.02.2014	WED 26.02.2014	THU 27.02.2014	FRI 28.02.2014
08:00	Registration and provision: presentations and posters (Foyer)	Registration and provision of power point presentations	Registration and provision of power point presentations	Registration and provision of power point presentations
08:30		Keynote Mark Ashton (HS 15)	Keynote Roman Vitting (HS 15)	Keynote Marielos Peña-Claros (HS 15)
09:15		Session 1: Tropical ecosystem processes in a changing world (HS15)	Session 6: Landscape ecology in the Neotropics (HS15)	Session 9: Impacts of land use on ecosystems (HS15)
09:30				
09:45		Session 3: Wildfire and management of tropical ecosystems (HS16)	Session 7: Free session (HS16)	Session 10: Tropical mycology and biodiversity (HS16)
10:00	Registration and provision: presentations and posters (Foyer)	Coffee/tea break (Foyer)	Coffee/Tea break (Foyer)	Coffee/tea break (Foyer)
		Session 4: Geoinformatics for tropical ecosystems (HS15)	Session 9: Impacts of land use on ecosystems (HS15)	Keynote Sven Günter (HS 15)
		Session 5: Strategies to conserve tropical forest ecosystems (HS16)	Session 8: Sustainable management in the tropical Andes (HS16)	Session 10: (HS16)
		Lunch break (Mensa)	Lunch break (Mensa)	Lunch break (Mensa)
	Opening and presidential address (HS15)	Keynote Teja Tschernik (HS 15)	Keynote Sylvie Goulet-Fleury (HS 15)	Closing ceremony & Merian Awards (HS 15)
15:00		Session 4: (HS15)	Session 9: (HS15)	Working group meeting ECUADOR (HS16)
15:15				
15:30		Coffee/Tea break (Foyer)	Coffee/Tea break (Foyer)	
15:45		Keynote Carlos Peres (HS 15)	Session 8: (HS16)	
16:00	Session 1: Tropical ecosystem processes in a changing world (HS 15)	Session 4: (HS15)	Session 9: (HS15)	
16:15		Session 2: Fragmentation in tropical landscapes (HS 16)	Session 8: (HS16)	
16:30				
16:45		Welcome reception / Posterparty (Foyer)	glo Assembly of members	
17:00				
17:15	Welcome reception / Posterparty (Foyer)	Public talk: Juliana Diller (at 18:00 until 20:30) (HS 15)	Conference dinner (at 20:00)	
17:30				
17:45				
18:00				
18:15				
18:30				



#### Anfahrt / How to get there (public transportation from train station):

Buslinie 638 Richtung Hittostaße/Fraunhofer Institut, Haltestelle Weihenstephan  
Bus line 638, destination Hittostaße/Fraunhofer Institut, exit Weihenstephan

Buslinie 639 Richtung Hittostaße/Fraunhofer Institut, Haltestelle Weihenstephan  
Bus line 639, destination Hittostaße/Fraunhofer Institut, exit Weihenstephan

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Bus line 639, destination Freising S-Bahn, exit Freising S-Bahn

#### Vom Bahnhof zum Flughafen / From the train station to the airport

Buslinie 635 Richtung Flughafen, MAC/Terminal 1 S-Terminal 2  
Bus line 635, destination Flughafen, MAC/Terminal 1 S-Terminal 2

# TROPICAL ECOSYSTEMS – BETWEEN PROTECTION AND PRODUCTION

Annual Conference of the  
Society for Tropical Ecology  
(Gesellschaft für Tropenökologie e.V. – gtö)

Technische Universität München  
February 25-28, 2014

## IMPRESSUM

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### Back cover photo

Tourismusamt Freising

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Society for Tropical Ecology  
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## TABLE OF CONTENTS

Welcome and Foreword . . . . .	4
Detailed Scientific Programme . . . . .	10
Plenary Keynotes – Abstracts . . . . .	24
Public Talk (in German) . . . . .	32
Scientific Poster Session – Abstracts . . . . .	140
The Conference Organizers . . . . .	184
The Society for Tropical Ecology . . . . .	185
Index of Participants . . . . .	186
Information for Participants . . . . .	196
Map of Conference Venue . . . . .	197





# **WELCOME AND FOREWORD**

**Dear participants, dear colleagues,**

It is a great pleasure to welcome you to the 27<sup>th</sup> Annual Conference of the Society for Tropical Ecology (gtö) at the Center of Life and Food Sciences Weihenstephan of the Technische Universität München. In spite of the fact that many research projects within the Center of Life and Food Sciences Weihenstephan are located in the tropics and are addressing tropical problems, the main focus of science in Weihenstephan is certainly not on tropical ecology. However there is a strong orientation of science towards land use, land use change, nutrition and nature conservation, which all address problems of tropical and global importance. The conflict between use and protection of ecosystems is not a specific feature in temperate regions; it is even of greater importance in tropical areas. Based on a long experience in managing ecosystems and a history of success and failure in the past scientists in Weihenstephan have developed strategies for more sustainable management of ecosystems combining different human demands in temperate regions which might have prospect for success in transfer and wise adjustment to the challenges in tropical areas.

Therefore, the overarching topic of our conference "Tropical ecosystems - between protection and production" is a real challenge. In view of the still increasing human population in the tropics and its rising demands for livelihood, production of food and energy, every endeavor has to be made to protect these ecosystems. Otherwise the dramatic loss of these tropical ecosystems with its high biodiversity and its inherent natural beauty due to the conversion into agricultural land or plantations for biofuel production seems inevitable.

The friends and members of gtö know on the one side that the actual degradation processes in the tropics will also affect themselves and people all over the world. So 20% of the CO<sub>2</sub>-emissions in the atmosphere are originating from land-use changes in the tropics and as CO<sub>2</sub> is an international currency without borders it will change the climate not only in the regions where it is generated. On the other hand friends and members of gtö are unified in the confidence that there are solutions for the problems in the tropics and that we have to contribute to identify these solutions.



Several sessions within our 27<sup>th</sup> Annual Conference in 2014 are directed to this issue. Based on scientific knowledge - and appreciating the experience of local population and their participation - it should be possible to give clues how we can overcome the conflict between protection and production in tropical ecosystems. And indeed there are some encouraging examples toward better integration of protection and production in tropical ecosystems considering its function as an overwhelming treasure of biodiversity.

On behalf of the organizing team

Reinhard Mosandl

Thomas Knoke

Michael Weber

Bernd Stimm

Patrick Hildebrandt



**Dear participants of the 27<sup>th</sup> annual conference of gtö,  
dear friends and colleagues,**

A look at the latest FAO statistics on forests seems to give good news: in many countries of the world, especially in the tropics, the forest area is increasing. A closer look at those figures however reveals a different message. Just look at the definition of “forests” and you will find, that rubber tree and christmas tree plantations are included as much as any other industrial plantation of trees. And, in addition, the figures can be only as good as those provided by the single countries, as FAO is not making an own, independent survey of the state of the world’s forests. The fast and ample expansion of oil palm plantations especially in South East Asia is in reality threatening and destroying natural forests and other ecosystems with all wildlife, the numbers of tigers and orang utans is dwindling which is not only a disaster per se but also only the “tip of the iceberg” (an expression not really harmonizing with our tropical field of work). The extinction crisis we are observing almost everywhere in the world is especially bad in the tropics. Of course, nowhere else do we have so many species, such a high diversity of life and so fast and widespread changes in land use. So, there is an urgent need to conserve and protect natural ecosystems. On the other hand tropical ecosystems are economically important and provide many ecosystem services and contain innumerable resources for the local people and for the consumers in our part of the world. Mankind cannot allow itself to take the “hands off approach”, not to use them at all. But we finally need to find and propagate forms of really sustainable use.



gtö is extremely grateful to the Technische Universität München (TUM) and the “Lehrstuhl für Waldbau”, especially to our dear friend and colleague Reinhard Mosandl and his team, who agreed to host and organize the 2014 conference of gtö.

“Tropical Ecosystems - Between Protection and Production” is the title of this important scientific meeting. We expect this to be an extremely interesting and productive meeting of scientists and conservationists, presenting and discussing problems and solutions and providing a number of new perspectives how tropical ecosystems can be used sustainably and be protected at the same time. And, how we can avoid that misleading figures give the public a wrong impression of what the reality in the tropics looks like.

We as researchers and scientists from all over the world have the obligation to be lobby for nature conservation. The more we are the stronger our impact will be. So, if you are not yet a member of gtö, just become one. It’s easy and rewarding!

I wish us all a successful conference!

Prof. Dr. Manfred Niekisch  
President of the Society for Tropical Ecology – gtö



**Dear participants and guests,**

The subject of the 27<sup>th</sup> Conference of the Society for Tropical Ecology „Tropical Ecosystems – between Protection and Production“ accommodates a major challenge: tropical ecosystems are biodiversity hotspots deserving protection on the one hand; but, on the other hand, they are simultaneously a major resource to satisfy the demand of an increasing world population for food, energy, recreation and a wide variety of further uses and services. One prerequisite for a concerted balance between protection and utilization of tropical ecosystems is a sound understanding of the ecological, economic and social processes.

Another requirement is the development of new strategies, techniques and scientific innovations for a sustainable management of the different resources. To fulfill these expectations it is crucial that researchers have an opportunity to present and discuss their results, which is the remit of this interdisciplinary conference.

I am very glad that you have chosen the Center of Life and Food Sciences Weihenstephan to host the conference. Addressing the aforementioned issues requires both basic and applied research, from molecular mechanisms to whole organisms, ecosystems and landscapes. Our faculty combines expertise in biosciences, biotechnology, agronomy, forestry, ecology, ecosystem management, ecological economics, nutrition, food sciences and life science engineering. Thus, the campus Weihenstephan of the Technische Universität München is a perfect place to discuss the many challenges faced by tropical ecosystems.

I am convinced that you will enjoy the presentations and stimulating discussions, which hopefully will lead to new inspirations and motivation. It's a pleasure to host you on our campus

A handwritten signature in dark ink, appearing to read 'A. Schnieke', with a long, sweeping horizontal line extending to the right.

Prof. Dr. Angelika Schnieke (Dean)





# **DETAILED SCIENTIFIC PROGRAMME**

## TUESDAY, FEBRUARY 25<sup>TH</sup>

- 10:00 Registration and provision: presentations and posters from 10:00 onwards (Foyer)
- 15:00 Opening and presidential address (HS15)
- 15:30 Keynote: Prof. Dr. Carlos A. Peres  
Large vertebrate defaunation modulates tropical forest ecosystem services (HS 15)
- 16:15 Parallel Sessions

### HS 15

#### TROPICAL ECOSYSTEM PROCESSES IN A CHANGING WORLD, P. 34

Chairs: Dana Berens, Ingo Grass

- 16:15 S1-O1 Ingo Grass  
Habitat loss and exotic plants reduce the functional diversity of pollinators in a subtropical landscape
- 16:30 S1-O2 Eliska Padysakova  
Importance of plant-pollinator relationships in a changing afromontane landscape
- 16:45 S1-O3 Štěpán Janeček  
Pollination interactions between sunbirds and *Impatiens* spp. along the altitudinal gradient on Mt. Cameroon
- 17:00 S1-O4 James Smith  
Winging it: using tower experiments and seed morphology to predict dispersal in tropical trees
- 17:15 S1-O5 Emma Morgan  
Supersized: demographic and genetic processes in the Coco de Mer, the largest-seeded plant in the world

### HS 16

#### FRAGMENTATION IN TROPICAL LANDSCAPES, P. 46

Chairs: Pia Parolin, Leandro V. Ferreira

- 16:15 S2-O1 Michael Senior  
Declining dung beetle ecosystem functions in response to tropical fragmentation
- 16:30 S2-O2 S.A. Ismail  
Fragmentation genetics of *Vateria indica*: implications for seed sourcing and forest restoration of an endemic dipterocarp
- 16:45 S2-O3 Katerina Sam  
Disappearance of birds from fragmented and secondary forests in Papua New Guinea and their predation pressure on insect
- 17:00 S2-O4 Friederike Naegeli de Torres  
Remote Sensing Based Mapping of pasture degradation in the fragmented landscape of Rio de Janeiro, Brazil
- 17:15 S2-O5 Pia Parolin  
Fragmentation of new islands formed in reservoirs in Amazonia

- 17:30 Welcome reception / Posterparty (Foyer)





## WEDNESDAY, FEBRUARY 26<sup>TH</sup>

- 8:00 Registration and provision of power point presentations
- 8:30 Keynote: Prof. Dr. Mark Ashton  
Ecological principles and silvicultural techniques for understanding degradation and restoration of tropical rainforests (HS 15)
- 9:15 Parallel Sessions

### WEDNESDAY

#### HS 15

##### TROPICAL ECOSYSTEM PROCESSES IN A CHANGING WORLD, P. 34

Chairs: Dana Berens, Ingo Grass

- 9:15 S1-O6 Franziska Peter  
Forest fragmentation interferes with the natural control of herbivores through insectivorous birds
- 9:30 S1-O7 Mikal Houadria  
Assessing trophic functions of ant communities in primary and secondary rainforest and comparing continents
- 9:45 S1-O8 Christine B. Schmitt  
Evaluation of species-climate relationships in the Ethiopian moist montane forests
- 10:00 S1-O9 Delicia Pino  
Seedling nutrient responses determine tree distribution patterns across nutrient gradients in tropical forests
- 10:15 S1-O10 Lisa Schöler  
Pollen-based temperature and precipitation inferences for the montane forest of Mt Kilimanjaro during the last Glacial and the Holocene

#### HS 16

##### WILDFIRES AND MANAGEMENT OF TROPICAL ECOSYSTEMS IN A CHANGING WORLD, P. 52

Chairs: Joachim Schmerbeck, Daniel Kraus

- 9:15 S3-O1 Siria Biagioni  
Assessing the long-term role of fire in the mountain rainforests of Lore Lindu National Park, Sulawesi, Indonesia
- 9:30 S3-O2 Jyoti Kashyap  
Fire frequency and plant diversity in tropical dry deciduous forest: a case study of Kumbhalgarh Wildlife Sanctuary, India
- 9:45 S3-O3 Denis Lippok  
Filters to tropical montane forest regeneration after fire
- 10:00 S3-O4 Peter Fiener  
Wild land fires and the supply of ecosystem services: consequences and perspectives for Indian tropical dry forests
- 10:15 S3-O5 Ilaria Palumbo  
New online fire monitoring tool for conservation

10:30 Coffee / Tea break (Foyer)

11:00 Parallel Sessions

#### HS 15

**GEOINFORMATICS FOR TROPICAL ECOSYSTEMS - TOOLS FOR CONSERVATION AND MANAGEMENT, P. 58**

Chairs: P.K. Joshi, J. Schmerbeck, C.P. Gross

- 11:00 S4-O1 Daniel Kübler  
Prediction of forest structure parameters in a tropical dry forest in the southwest of Madagascar using remote sensing imagery
- 11:15 S4-O2 Vincent Odongo  
Coupling socio-economic factors and eco-hydrological processes using a cascade-modeling approach
- 11:30 S4-O3 Francis Muthoni  
Spectral variation explains higher variance in plant  $\beta$ -diversity than spatial-autocorrelation
- 11:45 S4-O4 Nguyen Mai Phuong  
Application of GIS and Remote Sensing on assessment of land use/land cover changes in Bac Kan province, northern Vietnam during the period 2000–2010
- 12:00 S4-O5 Daniel Plugge  
Combined biomass inventory in the scope of REDD+
- 12:15 S4-O6 Philip Beckschäfer  
Mapping Leaf Area Index (LAI) – deriving LAI maps from remote sensing data and visualizing map uncertainties

#### HS 16

**STRATEGIES TO CONSERVE TROPICAL FOREST ECOSYSTEMS, P. 70**

Chair: Thomas Knoke

- 11:00 S5-O1 Carola Paul  
Reducing financial risks of reforestation by product diversification – an agroforestry approach
- 11:15 S5-O2 Janika Kerner  
Gallery forests of Kenya: land use meets conservation
- 11:30 S5-O3 Claudia Gray  
Strategies for biodiversity conservation in oil palm plantations
- 11:45 S5-O4 Nina Gallmetzer  
Low conservation value of oil palm agriculture for the herpetofauna of southern Costa Rica
- 12:00 S5-O5 Naret Guerrero Moreno  
Socio-economic characteristics of Manguzi traditional community as a pre-requisite for conservation, restoration and wise use of wetlands
- 12:15 S5-O6 Melissa Songer  
Human resource use and protection at Chatthin Wildlife Sanctuary, a protected dry tropical forest in Myanmar

WEDNESDAY

12:30 Lunch break (Mensa)



14:00 Keynote: Prof. Dr. Teja Tscharntke  
Conservation in tropical agroecosystems: biodiversity  
and associated services (HS 15)

14:45 Parallel Sessions

## HS 15

## SESSION CONTINUED

- 14:45 S4-07 Christoph Kleinn  
Estimating forest biomass:  
between heavenly global  
products and the devil in the  
detail
- 15:00 S4-08 Mengistie Kindu  
Classifying land use/land  
covers in Munessa–Shashemene  
landscape of the Ethiopian  
highlands using mono–temporal  
RapidEye image
- 15:15 S4-09 Cecilia Banag  
Bioclimatic niches of endemic  
*Ixora* species on the Philippines:  
potential threats by climate  
change

## HS 16

## SESSION CONTINUED

- 14:45 S5-07 Axel Hochkirch  
Invertebrate conservation in the  
tropics
- 15:00 S5-08 Dana G. Berens  
Supplementary food enhances  
nest-building in the endangered  
Cape vulture (*Gyps coprotheres*)
- 15:15 S5-09 Alessia Portaccio  
Endorsing REDD+ in the  
institutional mechanisms:  
how could tropical forests and  
voluntary initiatives be affected?

15:30 Coffee / Tea break (Foyer)

16:00 Parallel Sessions

## HS 15

## SESSION CONTINUED

- 16:00 S4-010 Nicolás Corti  
Forest Burned Area Mapping in  
Southern Ecuador using mono–  
temporal Rapid Eye imagery and  
Object Based Image Analysis
- 16:15 S4-011 Fabian Enßle  
Comparison of seven new  
forest inventory plots and first  
experiences with remotely  
controlled aerial vehicles

## HS 16

## SESSION CONTINUED

- 16:00 S5-010 Julia Susanne Kieck  
From coca to cocoa – economic  
sustainability of smallholder  
cocoa production by recovery of  
native cocoa varieties in Peru
- 16:15 S5-011 José Said Gutiérrez  
Ortega  
Towards the conservation  
of the neotropical cycad  
genus *Dioon* (Zamiaceae,  
Cycadales): implications from  
phylogeographic approach

17:00 Scientific poster session (Foyer)

**ECOSYSTEM PROCESSES AND GLOBAL CHANGE**

- Pollen analysis as a tool for estimating plant diversity dynamics in a hotspot region - possibilities and limits . . . . .(p. 141)
- Performance of *Pouteria torta* (Sapotaceae) seedlings after moderate addition of N and P in a premontane tropical forest in southern Ecuador . . . . .(p. 142)
- Activity pattern and foraging behavior of the tent - making bat (*Uroderma bilobatum*) in Panama . . . . .(p. 143)
- Tree growth responses to N and P fertilization in Ecuadorian montane forests . . . . .(p. 144)
- Unraveling responses of African species to climate variability and potential as climate proxies . . . . .(p. 145)
- Are carbon traits correlated to reproductive traits in tropical trees? A case study from the Dipterocarpaceae . . . . .(p. 146)
- Bioassays suggest that inducibility of direct defence strategies against herbivores is an abundant phenomenon in tropical plant species . . . .(p. 147)
- Take me to the river - seed dispersal in Amazonian floodplains . . . .(p. 148)
- High gene flow in two thrips - pollinated Southeast Asian pioneer trees . . . . .(p. 149)
- Late Holocene environmental change and human impact in south Kalimantan and north - east Java (Indonesia), inferred from marine sediment records . . . . .(p. 150)
- Long - term monitoring of demography and growth dynamics of three palm species in a Costa Rican premontane rainforest . . . . .(p. 151)
- Trends in diversity and abundance of feeding guilds in birds along a complete altitudinal rainforest gradient in Papua New Guinea . . . . .(p. 152)

**FRAGMENTATION IN TROPICAL LANDSCAPES**

- The abundance of rare tree species in remnant forests across the Visayas, Philippines . . . . .(p. 153)
- The importance of production and dispersal of propagules for mangrove regeneration in a tropical coastal lagoon system . . . . .(p. 154)
- Ten years of Czech ecological research in Cameroon . . . . .(p. 155)

**WILDFIRES AND MANAGEMENT OF TROPICAL ECOSYSTEMS**

- Towards understanding and managing spatial dynamics of tropical bracken (*Pteridium caudatum*) in the "Sierra del Lacandón" in Guatemala . . . .(p. 156)

WEDNESDAY



**GEOINFORMATICS FOR TROPICAL ECOSYSTEMS**

- Geotechnology and landscape ecology for monitoring forest fragmentation . . . . .(p. 157)
- Modeling the impacts of climate variability and logging on the dynamics of a dry tropical montane forest (Munessa Forest, Ethiopia) . . . . .(p. 158)
- Using 10 years' survey data to assess environmental variables associated with the distribution of Sumatra rhino in Sabah, Malaysia . . . . .(p. 159)

**STRATEGIES TO CONSERVE TROPICAL FOREST ECOSYSTEMS**

- Evaluating ecological and cultural services provided by tropical forest ecosystems: a case study in Indonesian Borneo . . . . .(p. 160)
- Protecting the Kenyan endemic bird species Hindes Babbler while improving water security . . . . .(p. 161)
- Under a changing climate: livelihood strategies in rural forest dependent communities. A socio - economic analysis from tropical Bolivia . . . . .(p. 162)
- Tree islands in a sea of oil palms - a measure of biodiversity conservation . . . . .(p. 163)

**LANDSCAPE ECOLOGY IN THE NEOTROPICS**

- Floristic diversity and reproductive patterns along an altitudinal gradient in Brazil . . . . .(p. 164)

**FREE SESSION**

- Water use of bamboos: methods test and first results . . . . .(p. 165)
- El Niño South Oscillation and its linkages with climatic system of South America during Mid-Holocene using CCSM reconstructions . . .(p. 166)
- Persisting in a windy habitat: population ecology and behavioral adaptations of two endemic grasshopper species in the Cape Region (South Africa) . .(p. 167)

**SUSTAINABLE MANAGEMENT IN THE TROPICAL ANDES**

- Phylodiversity responds much quicker to changes in elevation than taxonomic diversity . . . . .(p. 168)
- Small - scale spatial distribution of Piperaceae and Rubiaceae in a tropical mountain ecosystem in southern Ecuador . . . . .(p. 169)
- Wood characteristics of *Alchornea lojaensis* [Euphorbiaceae] . . . . .(p. 170)
- RendezWUE: canopy evapotranspiration meets water use efficiency of leaves . . . . .(p. 171)
- Integration of remote sensing techniques and ecosystem services information to measure degradation in the tropical rainforest of Ecuador . . . . .(p. 172)
- Spectral and structural properties of a tropical mountain forest by remote sensing . . . . .(p. 173)



## IMPACTS OF LAND USE ON ECOSYSTEMS

Does the importance of agroforests and tree plantations  
for forest birds in the Malay Archipelago depend on island size? . . . .(p. 174)

Reaction of bird communities to forest restoration in Sumatra . . . . .(p. 175)

Effects of logging, hunting and forest fragment size  
on faecal glucocorticoid levels of two neotropical primates . . . . .(p. 176)

The impact of climate change and land use change  
on Borneo's orang-utans . . . . .(p. 177)

Land Use and Livelihood Changes: a multi-scaled transformation process  
among the Shuar in the Alto Nangaritza (South Ecuador) . . . . .(p. 178)

How does logging influence dynamics of tree species diversity  
in a tropical rain forest in the Brazilian Amazon? . . . . .(p. 179)

Co - designing an agent - based model of bushmeat hunting  
using Interactive simulations with a stylized scale model . . . . .(p. 180)

## TROPICAL MYCOLOGY AND BIODIVERSITY

Small scale and large scale comparisons of arbuscular mycorrhizal fungal  
communities in tropical mountain forests in South Ecuador . . . . .(p. 181)

New morphological characters for the determination  
of Marantaceae in sterile stage . . . . .(p. 182)

19:00    Public talk: Dr. Juliane Diller ( until 20:30, HS 15)  
Fledermäuse und mehr - Forschung und Artenvielfalt  
im Regenwald von Panguana, Perú



## THURSDAY, FEBRUARY 27<sup>TH</sup>

- 8:00 Registration and provision of power point presentations
- 8:30 Keynote: Dr. Roman Wittig  
Culture, cognition, cooperation and conservation in wild chimpanzees:  
the Taï Chimpanzee Project (HS 15)
- 9:15 Parallel Sessions

### THURSDAY

#### HS 15

LANDSCAPE ECOLOGY IN THE  
NEOTROPICS: LAND USE CHANGE  
TRENDS AND SUSTAINABLE  
MANAGEMENT, P. 82  
Chair: Karl M. Wantzen

- 9:15 S6–01 Karl M Wantzen  
Cerrado: fragmentation and  
options for restoration
- 9:30 S6–02 Johannes Kollmann  
Degradation of biodiversity  
and ecosystem functioning in  
subtropical grasslands, and  
thresholds for restoration
- 9:45 S6–03 Simone Strey  
Land use change in Southern  
Pará, Central Brazil: a different  
response of topsoil and subsoil  
horizons
- 10:00 S6–04 Robert Strey  
Deep soil organic carbon: a call  
for greater consideration
- 10:15 S6–05 Graham Prescott  
Can oil palm expand without  
damaging biodiversity in  
Colombia?
- 10:30 S6–06 Jorge Antonio Gomez Diaz  
Herbaceous ferns and  
angiosperms as indicators of soil  
parameters along an altitudinal  
gradient at the Cofre de Perote  
(Veracruz, Mexico).

#### HS 16

FREE SESSION, P. 90  
Chair: Johannes Kollmann

- 9:15 S7–01 Erik Frank  
Helping behaviour on injured  
nestmates in the termite hunting  
ant species *Pachycondyla analis*
- 9:30 S7–02 Witold Lapinski  
Habitat use and ecomorphology  
in Central American wandering  
spiders
- 9:45 S7–03 Akanksha Singh  
Understanding multi-trophic  
interactions for aphid biocontrol  
on the tropical vegetable crop  
Okra: agricultural implications in  
Cameroon
- 10:00 S7–04 Heather Baldwin  
Coronavirus disease ecology in  
West African bats
- 10:15 S7–05 Teng-Chiu Lin  
Canopy gaps, understory light  
environments and seedling  
distribution in a subtropical  
rainforest experiencing annual  
typhoon disturbance

10:45 Coffee / Tea break (Foyer)

11:15 Parallel Sessions

### HS 15

**IMPACTS OF LAND USE ON ECOSYSTEMS: RESPONSES OF NATIVE BIOTA TO DIFFERENT FORMS OF LAND MANAGEMENT, P. 108**

Chairs: Julia Nowack, Joachim Nopper, Susanne Kobbe

11:15 S9-O1 Gemma Rutten  
Long term effects of logging on population structures and spatial distribution of dominant montane trees on Mt. Kilimanjaro

11:30 S9-O2 Julie Morin-Rivat  
The end of roaming in the forest causes a loss of timber resources: the paradox of slash and burn agriculture

11:45 S9-O3 Ervan Rutishauser  
Understanding the resilience of tropical production forest : the contribution of a new pan-tropical forest observatory

12:00 S9-O4 Arne Cierjacks  
Environmental and anthropogenic drivers of plant diversity and tree population ecology in grazed Caatinga dry forests of NE Brazil

### HS 16

**BETWEEN PRODUCTION AND PROTECTION - TOWARDS A SUSTAINABLE MANAGEMENT IN THE TROPICAL ANDES, P. 96**

Chairs: Jörg Bendix, Erwin Beck

11:15 S8-O1 Jörg Bendix  
Land use change in the tropical Andes of SE-Ecuador and its effects across scales

11:30 S8-O2 Nele Jantz  
Long-term vegetation responses to environmental changes across the south Ecuadorian Andes – a multi-site comparison

11:45 S8-O3 Darwin Pucha Cofrep  
Responses of a dry and humid tropical forest to climate variations in southern Ecuador: evidence from tree-rings width and stable isotope analyses

12:00 S8-O4 Thorsten Peters  
Impact of climate and climate change on the distribution of vascular plants in Southern Ecuador

12:15 S8-O5 Andre Lindner  
Climate change adaptation in the tropical Andes understanding and modelling local smallholder realities

THURSDAY

12:30 Lunch break (Mensa)



14:00 Keynote: Dr. Sylvie Gourlet-Fleury  
Balancing timber production and ecosystem services conservation  
in tropical forests: what is at stake? (HS 15)

14:45 Parallel Sessions

## HS 15

## SESSION CONTINUED

- 14:45 S9-O6 Zuzana Burivalova  
Not all logged forests are the  
same: identifying thresholds of  
logging intensity for maintaining  
tropical forest biodiversity
- 15:00 S9-O7 Eduardo Athayde  
Functional and phylogenetic  
diversity of scattered trees  
in agricultural landscape:  
implications for conservation and  
management
- 15:15 S9-O8 Yagya Adhikari  
Epiphytic orchids in a land use  
gradient in the Himalayas, Nepal

## HS 16

## SESSION CONTINUED

- 14:45 S8-O6 Erwin Beck  
Bad weeds grow tall: a  
compilation of ten years research  
on the bracken (*Pteridium* spp.)  
problem in the tropical Andes of  
South Ecuador
- 15:00 S8-O7 Claudia Armijos-Ojeda  
Local adaptation and  
anthropogenic impacts on  
*Cedrela odorata* L. across the  
tropical Andes: seed sources for  
reforestation in Ecuador
- 15:15 S8-O8 Pablo Quichimbo  
Forest site classification as basis  
for sustainable silviculture in  
southern Ecuador

THURSDAY

15:30 Coffee / Tea break (Foyer)

16:00 Parallel Sessions

HS 15	HS 16
<p><b>SESSION CONTINUED</b></p> <p>16:00 S9-O9 Roman Fricke Effects of traditional land use on diversity patterns of invertebrates and plants on the semi-arid Mahafaly plateau (SW-Madagascar)</p> <p>16:15 S9-O10 Sarah H Luke The impacts of logging and oil palm agriculture on stream invertebrates in Malaysian Borneo: can riparian margins mitigate the loss of biodiversity?</p> <p>16:30 S9-O11 Julian Glos Effects of anthropogenic disturbances on amphibian diversity in tropical rainforests</p> <p>16:45 S9-O12 Robert Tropek Conservation of the Gulf of Guinea Highlands from a butterfly perspective</p>	<p><b>SESSION CONTINUED</b></p> <p>16:00 S8-O9 Andre Velescu Low-level N, P and N+P amendments to a tropical montane forest in Ecuador: response of C and N cycles during the first five years</p> <p>16:15 S8-O10 Jürgen Homeier Effects of nutrient addition on fine litter production and leaf properties of Ecuadorian Andean forests</p> <p>16:30 S8-O11 Sebastian Paulick Tropical montane rainforests, a productivity and carbon cycle analysis</p>

17:15 gtö Assembly of members

20:00 Conference Dinner

THURSDAY





## FRIDAY, FEBRUARY 28<sup>TH</sup>

- 8:00 Registration and provision of power point presentations
- 8:30 Keynote: Dr. Marielos Peña-Claros  
Conserving tropical forests: the potential role of sustainable forest management (HS 15)
- 9:15 Parallel Sessions

### HS 15

#### IMPACTS OF LAND USE ON ECOSYSTEMS: RESPONSES OF NATIVE BIOTA TO DIFFERENT FORMS OF LAND MANAGEMENT, P. 108

Chairs: Julia Nowack, Joachim Nopper, Susanne Kobbe

- 9:15 S9-O13 Franziska K. Harich  
Rubber versus elephants: conflicts of human land-use and wildlife habitat in Southern Thailand
- 9:30 S9-O14 Nico Wilms-Posen  
Lease, land- use and livelihoods – a malaysian oil palm scheme and its social and ecological impacts
- 9:45 S9-O15 Jackson Rodrigues  
Understanding vegetation changes in the atlantic rainforest – multivariate analysis comparing pre-colonial and present pollen samples
- 10:00 S9-O16 Alabi Soneye  
Evaluation of land use change and climate variability in Ekiti Area of Nigeria
- 10:15 S9-O17 Marolyn Vidaurre de la Riva  
Climate change, poverty and livelihood: the current challenges of rural communities in the Andes

### HS 16

#### TROPICAL MYCOLOGY AND BIODIVERSITY, P. 130

Chair: Gerhard Kost

- 9:15 S10-O1 David Schellenberger Costa  
Species ranges, abundance and specialization
- 9:30 S10-O2 Martin Kazmierczak  
Patterns of local species richness in a tropical forest
- 9:45 S10-O3 József Geml  
Deep DNA sequencing of fungal communities in the Andean Yungas reveals high diversity and strong structuring among altitudinal forest types
- 10:00 S10-O4 Flavius Popa  
Fungal phylogeography and biodiversity of Yunnan (China)
- 10:15 S10-O5 Ludwig Beenken  
Phylogeographic patterns of neotropical rust fungi on Annonaceae

- 10:30 Coffee / Tea break (Foyer)
- 11:00 Keynote: PD Dr. Sven Günter  
Conservation in productive forest landscapes of the neotropics:  
the search for synergies and spatial scales (HS 15)
- 11:45 Parallel Sessions

HS 15	HS 16
SESSION CONTINUED	SESSION CONTINUED
11:45 S9-O18 Josef Settele Sustainable land management in irrigated rice landscapes in South-East Asia – the LEGATO project	11:45 S10-O6 Fabian Brambach Elevational patterns of tree diversity, endemism and phytogeographical affinities in mountain rain forests of Central Sulawesi, Indonesia
12:00 S9-O19 Manfred Türke A comparison of chemical and sustainable management of the invasive pest snail <i>Pomacea canaliculata</i> in irrigated rice fields in SE-Asia	12:00 S10-O7 Yoshiaki Tsuda Genetic structure of <i>Dysoxylum malabaricum</i> at several geographic scales in Western Ghats, India: Implications for conservation
12:15 S9-O20 Angelika Kölbl Changes in properties of different tropical soils exposed to paddy management	12:15 S10-O8 Chrispinus Rubanza Potential Biodiversity Values of Zaraninge Forest Reserve, North Eastern Tanzania
	12:30 S10-O9 Daniela Matenaar Species richness of Orthoptera in the UNESCO World Heritage site Cape Floral Region Protected Areas, South Africa

- 12:45 Lunch break (Mensa)
- 14:00 Closing ceremony & Merian Awards (HS15)
- 14:45 Working group meeting ECUADOR (HS16)



# PLENARY KEYNOTES – ABSTRACTS

Keynote speaker: Prof. Dr. Carlos A. Peres

## LARGE VERTEBRATE DEFAUNATION MODULATES TROPICAL FOREST ECOSYSTEM SERVICES

Prof. Dr. Carlos A. Peres<sup>1</sup>

<sup>1</sup>*School of Environmental Sciences, University of East Anglia, Norwich, UK,  
c.peres@uea.ac.uk*

Functional diversity (FD) of pollinators increases plant reproductive output and the stability of plant-pollinator communities. Yet, in times of worldwide pollinator declines, effects of global change on pollinator FD remain poorly understood. Loss of natural habitat and exotic plant invasions are two major global change drivers that particularly threaten pollinator diversity. In a subtropical landscape, we investigated changes in the FD of pollinator assemblages along gradients of natural habitat loss and relative abundance of exotic plants. We used a dataset of 1434 pollinator individuals sampled on 131 focal plants and calculated the FD in three pollinator traits that are strongly related to pollination processes: proboscis length, proboscis diameter and body length. Multivariate FD of pollinators decreased with both increasing habitat loss and exotic abundance. Importantly, changes in FD went beyond those in pollinator richness. Furthermore, richness was not related to habitat loss or exotic abundance. Loss in multivariate FD was mediated by complementary negative effects of habitat loss on FD in proboscis length and exotic abundance on FD in body length. Correspondingly, we found lower abundances of long-tongued pollinators with habitat loss and reduced variance in body size with both drivers. In contrast, FD in proboscis diameter was unaffected by either driver. Our results show that both natural habitat loss and exotic plants negatively affect pollinator FD, which may imperil pollination of specialised plant species in degraded habitats. Pollinator richness is a poor proxy for pollinator FD and likely insufficient when assessing pollination processes. Distinct responses of pollinator traits to the two drivers suggest limited options to infer relations of one trait to another. Finally, additive effects of habitat loss and exotic plants highlight the need to consider multiple global change drivers when investigating ecosystem processes at a community scale.

TUESDAY 15:30



Keynote speaker: Prof. Dr. Mark Ashton

## ECOLOGICAL PRINCIPLES AND SILVICULTURAL TECHNIQUES FOR UNDERSTANDING DEGRADATION AND RESTORATION OF TROPICAL RAINFORESTS

Prof. Dr. Mark Ashton<sup>1</sup>

<sup>1</sup>*Yale School of Forestry & Environmental Studies, New Haven, USA,  
mark.ashton@yale.edu*

In the last thirty years the governments of many countries have changed their policies toward their remaining tropical rain forest from one that promoted commercial exploitation to one of conservation. Many countries and organizations have developed active reforestation programs with native species. However, few guidelines have been developed in providing a framework for understanding degradation and restoration processes. The growing importance of upland areas as catchments for water production, biodiversity conservation, non-timber forest products, high quality timbers and the provision of other downstream services has growing recognition. It is therefore timely that we provide such a framework based on twenty five years of research investigating tropical rain forest dynamics with the objective of using this knowledge for forest restoration. We provide seven common principles for understanding the integrity of rain forest dynamics. The principles are: 1) underlying hydrology and soil fertility of soils drive and shape floristic productivity; 2) disturbance type, scale and frequency provide the simultaneous initiation and/or release of a new forest stand in relation to physiography and in interaction with soils; 3) disturbances are dominated by initial floristics; 4) kinds of regeneration are diverse and can be categorized into guild by successional status and growth habit; 5) advance regeneration plays a disproportionate role in guild and habitat diversity; 6) late successional tree species primarily differentiate spatially through processes of competitive hierarchy and density dependence; and 7) tree canopy stratification is based on both "static" and "dynamic" processes. These principles are applied to determine effects of two rain forest degradation processes that have been characterized as chronic (continuous detrimental impacts) and acute (one-time detrimental impacts). Restoration pathways are suggested that range from: 1) the simple prevention of disturbance to promote release of rain forest succession; 2) site-specific enrichment planting protocols for canopy trees; 3) sequential amelioration of arrested fern and grasslands by use of plantation analogs of old field pine to facilitate secondary succession of rain forest, and plantings of late-seral rain forest tree species; and 4) establishment and release of successional compatible mixed-species plantations. We summarize with a synthesis of the restoration techniques proposed for reforestation in tropical forest regions.

Keynote speaker: Prof. Dr. Teja Tscharntke

## **CONSERVATION IN TROPICAL AGROECOSYSTEMS: BIODIVERSITY AND ASSOCIATED SERVICES**

Prof. Dr. Teja Tscharntke<sup>1</sup>

<sup>1</sup>*Georg-August-Universität Göttingen, Göttingen, Germany, [ttschar@gwdg.de](mailto:ttschar@gwdg.de)*

Agricultural transformation of habitat is the most important driver of global change. Agricultural land covers 40 % of terrestrial area, whereas protected areas just 12 %, so any changes in agricultural practices greatly affect communities and food web interactions. Hence, combining agriculture and conservation is a major challenge.

Small-scale agroforestry can provide both high yields and functionally important biodiversity (e.g. for biocontrol and pollination). However, biodiversity-friendly agroecosystems often do not persist for long time because of yield-maximizing instead of risk-avoiding strategies (e.g. long-term cacao boom-and-bust) and fluctuating market prices. Broadening the view from local to landscape-moderated effects, including forest-crop spillover enhancing pollination and biocontrol, is needed for a better understanding of management decisions. The role of crop pollination is often underestimated but globally most important (affecting 35 % of crop production). For example, coffee pollination needs the bee diversity, enhanced by adjacent forests. Stabilizing high yield needs functional biodiversity, which depends on environmentally friendly agricultural practices. Nevertheless, protection of rainforest remnants has priority in conservation, so combining land “sharing” with “sparing” (without compromising yield) would be the best strategy for both sustainable agriculture and biodiversity conservation.

WEDNESDAY 14:00



Keynote speaker: Dr. Roman Wittig

## **CULTURE, COGNITION, COOPERATION AND CONSERVATION IN WILD CHIMPANZEES: THE TAI CHIMPANZEE PROJECT**

Dr. Roman Wittig<sup>1</sup>

<sup>1</sup>*Department of Primatology, Planck Institute for Evolutionary Anthropology, Leipzig, Germany, wittig@eva.mpg.de*

The Tai National Park (TNP) has recently been identified as one of the most irreplaceable protected areas for overall biodiversity and threatened species (Science Vol 342, 15 Nov 2013). Located in the south-west of Ivory Coast, at the boarder to Liberia, TNP is one of the last remaining primary forest area of the Upper Guinean Forest System. Although TNP has been established a UNESCO World Heritage Site in 1982, its unique fauna is facing severe problems. Poaching, habitat loss and lethal pathogens endanger TNP's unique wildlife including its population of chimpanzees (*Pan troglodytes verus*). Established in 1979, the Tai Chimpanzee Project observes and protects the chimpanzees of the TNP.

Chimpanzees are a flagship species for the protection of African rainforest habitat. Being our closest living relatives, chimpanzees differ in less than 1% of their DNA from our own. This unique evolutionary position of chimpanzees is also reflected in their behaviour. They live in fission-fusion communities of 20 – 200 individuals and inhabit the forests and wood-savannahs across tropical Africa. Being an ecological conservative species, chimpanzees allow us to get a feeling for how our ancestors may have lived 6-8 million years ago.

In this talk I will present data from the last 5 years of research on chimpanzees in Tai and other study sites in Africa. I will review the cultural differences of wild chimpanzee populations across Africa and show you some evidence for cultural differences in nut cracking between neighbouring communities in Tai. I will show you how cooperative behaviours in chimpanzees help to mediate friendships in close kin and distantly-related chimpanzees. Following, I will present you some field experiments with wild chimpanzees investigating how competition and cooperation has shaped their social cognition. Finally I will show you which role research can play in the protection of an endangered species and how the Tai Chimpanzee Project protects the chimpanzees and the entire fauna of TNP.

THURSDAY 08:30



Keynote speaker: Dr. Sylvie Gourlet-Fleury

## **BALANCING TIMBER PRODUCTION AND ECOSYSTEM SERVICES CONSERVATION IN TROPICAL FORESTS: WHAT IS AT STAKE?**

Dr. Sylvie Gourlet-Fleury<sup>1</sup>

<sup>1</sup>*Cirad Agricultural Research for Development, Montpellier, France,  
sylvie.gourlet-fleury@cirad.fr*

Tropical forests are facing increasing anthropogenic pressure. Timber logging, in particular, is being accused of degrading the forests, either directly or indirectly. Whether timber can be produced sustainably has been a highly controversial topic, questioning possible trade-offs between timber production and the conservation of other ecosystem services. There is now good evidence that timber stock recovery cannot be ensured with the rules (felling cycles, diameter cutting limits) currently ongoing in most production forests, while those forests remain critical reserves of species diversity and carbon stocks.

I will present some key findings from long-term experimental plots and a large-scale study led in the central African region. As elsewhere, we have demonstrated that current logging practices in concessions under management plans are depleting timber stocks, an all the more worrying finding than those plans are deemed to be sustainable. In the same time, effects on tree species diversity eventually remains limited and carbon stocks can recover very fast. However, there is great heterogeneity between forests, some appearing less productive than others, an issue poorly addressed in current land policies.

I will show how models can be useful to draw attention of decision-makers on problematic futures and I will highlight some critical gaps in our knowledge of how species will cope with combined anthropogenic and environmental stress. I will present some of the options that we are currently working on to foster better management practices in the region.

THURSDAY 14:00



Keynote speaker: Dr. Marielos Peña-Claros

## CONSERVING TROPICAL FORESTS: THE POTENTIAL ROLE OF SUSTAINABLE FOREST MANAGEMENT

Dr. Marielos Peña-Claros<sup>1</sup>

<sup>1</sup>*Wageningen University, The Netherlands, marielos.penaclaros@wur.nl*

Sustainable forest management has been proposed as a conservation strategy for tropical forests, by adding value based on the sustainable use of forests as a natural resource. Although many ecological questions about the implementation of this strategy remain unanswered, ecological studies have largely focused on showing the detrimental effects of conventional logging rather than providing basic information needed to improve forest management practices. In this presentation I first make use of several studies carried out in the tropics to assess the impact of selective logging on biodiversity, forest dynamics, and ecosystem services. Results show that the impact of logging varies with logging intensity and with the parameter considered. The impact of logging on biodiversity is smaller than the impact on timber volume or carbon stocks. Next I highlight some silvicultural treatments that aim at improved growth of timber trees (such as liberation from lianas and other competing trees), at increasing regeneration of commercial species, and at speeding up forest recovery. The data for this part of my presentation come from the Long-term Silvicultural Research Program (being carried out by the Bolivian Forest Research Institute) in which plots received different intensities of logging and application of silvicultural treatments. Results show that under conditions of low logging intensity as in the case of these plots in Bolivia, growth and recruitment rates were higher in plots receiving additional silvicultural treatments (i.e., logging plus additional silvicultural treatments) than in the normal logging treatment (i.e., only logging using reduced impact logging techniques). The changes in forest dynamics resulted in changes in the functional properties of the tree community (i.e., increases in community-weighted mean of specific leaf area and leaf nitrogen concentration, and decreases in wood density) but not in changes in species richness and the diversity of functional properties. These results suggest that not only reduced impact logging but also additional silvicultural are needed to increase forest recovery. Finally, I argue that ecological knowledge is key to define best management practices for tropical forests, and therefore, ecologists can - and need to - play a more active role in making management practices ecologically sound and environmentally sustainable.

FRIDAY 08:30

Keynote speaker: PD Dr. Sven Günter

## **CONSERVATION IN PRODUCTIVE FOREST LANDSCAPES OF THE NEOTROPICS: THE SEARCH FOR SYNERGIES AND SPATIAL SCALES**

PD Dr. Sven Günter<sup>1</sup>

<sup>1</sup>*CATIE Centro Agronómico Tropical de Investigación y Enseñanza, Costa Rica, [sgunter@catie.ac.cr](mailto:sgunter@catie.ac.cr)*

Increasing claims on land use and global change present new challenges for conservation of biodiversity and sustainable management of forest resources in tropical landscapes. Integrative landscape approaches are needed for harmonizing conflicting land use options, but the combination of conservation and productivity aims is frequently confronted with the problem of high opportunity costs and incompatible spatial scales. The search for synergies and appropriate scales is thus of high priority for research agendas of conservationists and landscape managers. In this presentation we show examples of scaling and compatibility problems from Costa Rica and Ecuador, e.g. trade-offs between carbon sequestration, biodiversity and income in agroforestry systems, potential and limitations of natural forest management in tropical montane ecosystems and the concept of biological corridors in times of global change. Based on these case studies, we discuss the viability of integrative landscape approaches as strategy for conservation and sustainable land use, highlighting the importance of tropical ecologists as facilitators of interdisciplinary concepts for managers and decision makers.

FRIDAY 11:00



# **PUBLIC TALK (IN GERMAN)**

**ELISABETH KALKO MEMORIAL LECTURE**

## FLEDERMÄUSE UND MEHR - FORSCHUNG UND ARTENVIELFALT IM REGENWALD VON PANGUANA, PERÚ

Dr. Juliane Diller<sup>1</sup>

<sup>1</sup>*Zoologische Staatssammlung München, [juliane.diller@zsm.mwn.de](mailto:juliane.diller@zsm.mwn.de)*

Die biologische Forschungsstation „Panguana“ wurde 1968 von dem deutschen Forscher-Ehepaar Koepcke im Tieflandregenwald von Perú gegründet und ist ein wahrer Hotspot der Biodiversität. Das 9 km<sup>2</sup> große, mit unberührtem Primärwald bedeckte Studiengebiet wird heute von der Tochter der Begründer, der Biologin Dr. Juliane Diller geleitet, die an der Zoologischen Staatssammlung München arbeitet.

Panguanas unglaubliche Artenvielfalt ist ein unerschöpflicher Fundus für spannende Forschungsarbeit, die Wissenschaftler aus aller Welt dort seit über 40 Jahren leisten und in zahlreichen Publikationen dokumentiert haben. Die Zoologische Staatssammlung München führt seit 2000 regelmäßig Expeditionen nach Panguana durch und untersucht zurzeit vor allem die unerschöpflich reiche Insektenwelt. J. Diller studierte für ihre Doktorarbeit in den 1980er Jahren die Fledermäuse der Region und ihre Ökologie.

Eine langfristige Kombination von Grundlagenforschung, Regenwaldschutz und sozialen Projekten hat diese älteste biologische Station in Perú zu einem Erfolgsmodell werden lassen und dazu geführt, dass Panguana heute ein offiziell von der peruanischen Regierung anerkanntes, privates Naturschutzgebiet ist.

Juliane Diller entführt uns mit ihrem Vortrag in einen den meisten Menschen fremden, rätselhaften Lebensraum am anderen Ende der Welt, gibt Einblick in das faszinierende Ökosystem von Panguana und berichtet über die aktuelle Forschungsarbeit vor Ort. Neben der Vielfalt von Flora und Fauna, in der die Fledermäuse einen besonderen Platz einnehmen, wird zugleich auch die immer dramatischer wachsende Bedrohung der amazonischen Regenwälder beleuchtet, deren Erhalt für den Fortbestand unserer eigenen europäischen Welt von entscheidender Bedeutung ist.

WEDNESDAY 19:00



# SESSION 1:

## TROPICAL ECOSYSTEM PROCESSES IN A CHANGING WORLD

[ Short title: Ecosystem processes and global change ]

Chairs: Dr. Dana Berens, Ingo Grass

Contact: [dana.berens@staff.uni-marburg.de](mailto:dana.berens@staff.uni-marburg.de)

Tropical ecosystems are increasingly under pressure from drivers of global change such as human land-use, biotic invasions or climate change. These drivers have profound effects on the composition of species communities as well as on the interactions within and among them. In turn, essential ecosystem processes and services, such as herbivory, pollination or seed dispersal, are imperilled. This session will present novel findings from innovative research focusing on e.g. the functional and phylogenetic composition of communities, food web ecology or population genetics. The session will increase our understanding and enhance predictions of contemporary and future consequences of global change on the functioning of tropical ecosystems.

## HABITAT LOSS AND EXOTIC PLANTS REDUCE THE FUNCTIONAL DIVERSITY OF POLLINATORS IN A SUBTROPICAL LANDSCAPE

Ingo Grass<sup>1</sup>, Dana Berens<sup>1</sup>, Nina Farwig<sup>1</sup>

<sup>1</sup>*Philipps-Universität Marburg, Marburg, DE, grass@staff.uni-marburg.de*

Functional diversity (FD) of pollinators increases plant reproductive output and the stability of plant-pollinator communities. Yet, in times of worldwide pollinator declines, effects of global change on pollinator FD remain poorly understood. Loss of natural habitat and exotic plant invasions are two major global change drivers that particularly threaten pollinator diversity. In a subtropical landscape, we investigated changes in the FD of pollinator assemblages along gradients of natural habitat loss and relative abundance of exotic plants. We used a dataset of 1434 pollinator individuals sampled on 131 focal plants and calculated the FD in three pollinator traits that are strongly related to pollination processes: proboscis length, proboscis diameter and body length. Multivariate FD of pollinators decreased with both increasing habitat loss and exotic abundance. Importantly, changes in FD went beyond those in pollinator richness. Furthermore, richness was not related to habitat loss or exotic abundance. Loss in multivariate FD was mediated by complementary negative effects of habitat loss on FD in proboscis length and exotic abundance on FD in body length. Correspondingly, we found lower abundances of long-tongued pollinators with habitat loss and reduced variance in body size with both drivers. In contrast, FD in proboscis diameter was unaffected by either driver. Our results show that both natural habitat loss and exotic plants negatively affect pollinator FD, which may imperil pollination of specialised plant species in degraded habitats. Pollinator richness is a poor proxy for pollinator FD and likely insufficient when assessing pollination processes. Distinct responses of pollinator traits to the two drivers suggest limited options to infer relations of one trait to another. Finally, additive effects of habitat loss and exotic plants highlight the need to consider multiple global change drivers when investigating ecosystem processes at a community scale.

**Merian Award Applicant**

TUESDAY 16:15



## IMPORTANCE OF PLANT-POLLINATOR RELATIONSHIPS IN A CHANGING AFROMONTANE LANDSCAPE

Eliska Padysakova<sup>1,2</sup>

<sup>1</sup>*Faculty of Sciences, University of South Bohemia, Ceske Budejovice, CZ, [paddysek@gmail.com](mailto:paddysek@gmail.com)*

<sup>2</sup>*Institute of Botany, Czech Academy of Sciences, Pruhonice, CZ, [paddysek@gmail.com](mailto:paddysek@gmail.com)*

Plant-pollinator interactions are essential processes generating and maintaining biodiversity. The knowledge of these interactions is crucial, particularly in areas where human-caused habitat destruction might change population dynamics of individual organisms. We assessed sunbird-plant relationships in highly fragmented landscape of Bamenda Highlands, Cameroon, to know how specialized or generalized both flowers and bird pollinators really are. For this reason we compared food preferences of three sunbird species feeding on the nectar of five plant species in afromontane vegetation. The feeding behavior was related to the degree of phenotypic matching between flowers and sunbird bills. The results clearly showed that although sunbirds frequently fed on both morphologically specialized and unspecialized flowers, food selectivity supported the hypothesis of phenotypic complementarities in specialized plant-pollinator interactions. Specifically sunbirds selected preferentially flowers with corolla lengths similar to the lengths of their bills and this selectivity decreased for plants with either longer or shorter corollas. The shortest-billed sunbird provides one exception of this scenario as it avoided flower size constraints by piercing the flower spur and stealing the nectar of the plant with long corollas. This endemic plant species with such flower traits is exclusively visited by two sunbird species but effectively pollinated mainly by the longest-billed sunbird. We emphasize, that the long-term conservation programs target on endemic highly-specialized plants should consider not only the plant itself but also its potential pollinators.



## POLLINATION INTERACTIONS BETWEEN SUNBIRDS AND *IMPATIENS* SPP. ALONG THE ALTITUDINAL GRADIENT ON MT. CAMEROON

Štěpán Janeček<sup>1</sup>, Michael Bartoš<sup>1</sup>

<sup>1</sup>*Institute of Botany ASCR, Trebon, CZ, janecek.stepan@centrum.cz*

The flowers of many African *Impatiens* spp. show a typical bird pollination syndrome and are expected to be pollinated by sunbirds. Although many *Impatiens* spp. in tropical Africa that grow on isolated mountains are endemic and endangered by the current destruction of tropical forests, the interactions between sunbirds and *Impatiens* spp. are rarely studied.

In our study, we targeted the interactions between five *Impatiens* spp. and 22 sunbird species along the altitudinal gradient on Mt. Cameroon. The study aimed to answer following questions: 1. How are the *Impatiens* spp. distributed along an altitudinal gradient? 2. Are the species that have evolved the bird pollination syndrome actually pollinated by sunbirds? 3. Are the individual species generalised or specialised? 4. Does the pollination by different sunbird species occur along an altitudinal gradient? and 5. What should be the conservation priorities to protect the endemic *Impatiens* plants?

Because four of the five *Impatiens* spp. that were used in our study flower in the wet season, we conducted the study during this period (June to September). At each target altitude (2200, 1800, 1500, 1100, 600 and 300 m asl), we attempted to identify the *Impatiens* spp. For monitoring of pollinators, we used remote video camera systems. We recorded five individuals of each *Impatiens* species at each altitude (or less in case of insufficient individual plants). Then, we set up the camera systems and monitored the video recordings to determine the visitors of individual plants.

*Impatiens* spp. were generally common along the altitudinal gradient except at an elevation of 300 m asl, but they tended to be found at different altitudinal ranges. All observed plant species were pollinated by sunbirds. Although 22 sunbird species have been recorded on Mt. Cameroon, all plants were legitimately visited regularly only by one sunbird species, *Cyanomitra oritis*, which is the endemic sunbird in the Cameroonian mountains. Another sunbird species that visited the *Impatiens* spp. occasionally and often thieved the nectar by piercing the spur without contact with the anthers and/or stigma. Considering the extreme specialisation of *Impatiens* spp. on Mt. Cameroon, conservation priorities should target not only the endemic *Impatiens* spp. but also the conservation of its key pollinator *C. oritis*.



## WINGING IT: USING TOWER EXPERIMENTS AND SEED MORPHOLOGY TO PREDICT DISPERSAL IN TROPICAL TREES

James Smith<sup>1</sup>, Judith Ellens<sup>1</sup>, Chris Kettle<sup>1</sup>, Robert Bagchi<sup>1</sup>, Colin Maycock<sup>3</sup>, Eyen Khoo<sup>2</sup>, David Burslem<sup>4</sup>, Jaboury Ghazoul<sup>1</sup>

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<sup>4</sup>University of Aberdeen, Aberdeen, UK

In view of the widespread loss and degradation of Southeast Asian tropical forests there is much interest in ecological processes that facilitate forest recovery and regeneration. Of central interest is the seed production and dispersal of trees belonging to the Dipterocarpaceae family, which may constitute over 40% of lowland forest biomass. Dipterocarps mostly have winged fruits that gyrate to the ground following irregular inter-annual masting events. Dispersal is generally poor, but there is wide variability in fruit size and wing morphology which might reflect species specific differences in dispersal capacities. Such variation has implications for dispersal to, and colonization of, degraded forest microsites with further implications for future forest compositional trajectories. We explored experimentally how inverse wing loading (IWL) affects the shape of seed dispersal kernels among 13 dipterocarp species using fruit releases from a canopy tower. Dispersal increased with IWL, and especially so at high wind speeds. Dispersal distances were low (90% within 10 m), confirming that the majority of seed dispersal is local, but there are substantial dispersal differences among species that can be related to IWL. We hypothesize that such poor seed dispersal leads to clumped spatial aggregations and strong fine-scale genetic structuring within dipterocarp populations. This may leave this family vulnerable to inbreeding and genetic drift in degraded or fragmented forests. We further present a database of expected dispersal kernels for a range of IWL values from 1 to 50 (encompassing 75% of Bornean dipterocarps). This database will facilitate trait based analyses of dipterocarp ecology and an assessment of dipterocarp species vulnerabilities.

**Merian Award Applicant**

## SUPERSIZED: DEMOGRAPHIC AND GENETIC PROCESSES IN THE COCO DE MER, THE LARGEST-SEEDED PLANT IN THE WORLD

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The extraordinary *Lodoicea maldivica* (Coco de Mer) is an endangered, dioecious palm found on the granitic islands of Praslin and Curieuse in the Seychelles. This giant island endemic produces “seeds” weighing an average of 10 kg, enclosed in a fruit weighing up to 20 kg. Consequently, this remarkable palm has extremely limited seed dispersal. The species has suffered extensive alteration of habitat and is heavily exploited due to over-harvesting and poaching of nuts. Despite its global significance, the reproductive ecology and regeneration patterns in *L. maldivica* remain poorly understood, partly due to its incredibly slow growth rate and long generation time.

In this study we use demographic and genetic approaches to investigate remnant patches of *L. maldivica* exhibiting “natural” regeneration. Using a set of 14 microsatellite loci we reconstruct the population structure that developed under natural conditions. We evaluate inbreeding coefficients in different age classes, and quantify the fine-scale spatial genetic structure among the cohorts and sexes. This will allow us to determine the effects habitat degradation and historic management practices have had on the species. This data enables us to examine gene flow by pollen in this species, and its role in maintaining genetic diversity among fragmented subpopulations. *Lodoicea maldivica* provides a powerful study system for investigating the long-term effects of habitat fragmentation in a poorly-dispersing tropical plant species.



## FOREST FRAGMENTATION INTERFERES WITH THE NATURAL CONTROL OF HERBIVORES THROUGH INSECTIVOROUS BIRDS

Franziska Peter<sup>1</sup>, Dana G. Berens<sup>1</sup>, Nina Farwig<sup>1</sup>

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WEDNESDAY 09:15

The ongoing fragmentation of forests has been suggested to drive changes in the structure and composition of bird communities. As birds provide vital ecosystem services such as the natural control of herbivorous insects these changes may have direct implications for plant performance on the individual level as well as long-term consequences for forest regeneration. Yet, there is little knowledge regarding the effect of forest fragmentation on insectivorous birds and related changes in their trophic performance as control agents of herbivores. Our study aimed to investigate the effect of forest fragmentation on the landscape scale on the composition of bird communities and on the abundance of insectivorous birds in subtropical forests. Using enclosure experiments, we further wanted to evaluate whether changes in the abundance of insectivorous birds translated into changes in leaf area loss of plants mediated by shifts in the herbivore communities. The results of our study suggest that increasing forest fragmentation significantly affected the composition of local bird communities, particularly via decreased abundances of forest-associated, insectivorous birds. Furthermore, outside the bird enclosures, the accumulation in leaf area loss throughout the season slightly decreased with increasing abundances of insectivorous birds. In contrast, inside enclosures, the accumulation in leaf area loss during the season showed a strong increase with increasing abundances of insectivorous birds. Thus, our findings suggest a biological control of herbivores by insectivorous birds what, in turn, may result in lower susceptibility of plants in terms of herbivory. The exclusion of those biological control agents interrupts this trophic link increasing the susceptibility of herbivory. Finally, as forest fragmentation lead to a loss of insectivorous birds, forest fragmentation simultaneously may imperil the natural control of herbivore populations, ultimately increasing levels of herbivory. Consequently, forest fragmentation may jeopardize plant performance and forest regeneration in highly fragmented landscapes.

## ASSESSING TROPHIC FUNCTIONS OF ANT COMMUNITIES IN PRIMARY AND SECONDARY RAINFOREST AND COMPARING CONTINENTS

Menzel Florian<sup>1</sup>, Mikal Houadria<sup>1</sup>, Orivel Jérôme<sup>1</sup>, Salas-Lopez Alex<sup>2</sup>, Blüthgen Nico<sup>4</sup>

<sup>1</sup>*Department of Evolutionary Biology, Institute of Zoology, Mainz, DE*

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<sup>4</sup>*Department of Biology, Technical University of Darmstadt, Darmstadt, DE*

Tropical forests will experience a large reduction in biodiversity should current trends in human activity continue. However, biodiversity loss is often accompanied by loss of ecosystem functioning. For ants, biodiversity changes between primary and secondary forests are well-studied. Since ants are highly abundant in rainforests, it is likely that changes in the ant community will have significant impact on the ecosystem. However, the ecosystem functions ants are involved in are little studied to date.

Here we present a new methodology, simultaneously assessing, dietary and temporal specialisation, species-wise, for whole ant communities. We used eight baits that reflected different natural resources. On a grid system, each bait was offered during day and at night. This way, we assessed dietary and temporal niche differentiation within the ant community, as well as the trophic functions performed by ants and functional redundancy in the ant community.

We applied the methodology in primary and secondary rainforest in the paleotropics and the neotropics. Our results indicate that:

1. Ant community is composed of a full range of varying food specialists and temporally specialised species, promoting species coexistence.
2. Ant diversity can increase functional diversity as well as functional redundancy; therefore degradation of community structure does not always go in tandem with degradation of trophic functions.
3. Certain ant species in relation to their abundance, type of food specialisation and temporal breadth, play key roles in structuring the food web of tropical rainforests.
4. Parallels are found in the trophic functions performed by ant communities of distant tropical regions.

WEDNESDAY 09:30



## EVALUATION OF SPECIES-CLIMATE RELATIONSHIPS IN THE ETHIOPIAN MOIST MONTANE FORESTS

Christine B. Schmitt<sup>1</sup>, Cristabel Durán-Rangel<sup>1</sup>, Carsten F. Dormann<sup>1</sup>, Feyera Senbeta<sup>2</sup>, Tadesse Woldemariam<sup>3</sup>

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<sup>3</sup>Environment and Coffee Forest Forum, Addis Abbaba, ET

WEDNESDAY 09:45

The Ethiopian moist montane forests host high species diversity and are likely to be strongly affected by climate change, as are tropical mountain forest ecosystems worldwide. It is difficult, however, to estimate the impacts of a changing climate on tropical plant species because their specific environmental requirements are often only incompletely known. This project therefore aims at identifying the critical climatic factors for the distribution of selected tree species from the Ethiopian moist montane forests as a basis for modelling their current and future distributional ranges. The analyses are based on species abundance data from 180 study plots distributed across five moist montane forest areas in southwestern and southeastern Ethiopia (1000 - 2300 m a.s.l.) and on climatic data from the World Clim global climate data set. Species and climatic data are analysed using ordination techniques and multivariate regression trees (MRT). Furthermore, the distribution of species in relation to climatic factors is modelled with the Random Forest Model and Generalized Linear Models GLM). Models are cross-validated and their precision is evaluated with bootstrap methods, reproduced on effect-plots for each significant climatic factor. Species are selected based on the robustness of the statistical results as well as ecological and socioeconomic importance. Preliminary results show that the distribution range and abundance of individual tree species differ strongly between the Ethiopian moist montane forest areas, which have highly variable temperature and precipitation regimes. Generally, in areas with high precipitation during the warmest quarter ( $\geq 288$  mm) and low minimum temperature in the coldest month ( $< 10.9$  °C), the number of Afromontane species is highest and that of Guineo-Congolian species lowest. The predicted increase in temperature for the Ethiopian highlands is thus likely to affect the distribution of the Afromontane species, which are now prevalent in the forest areas with low minimum temperatures. The relationship between each tree species and the climatic factors will be further scrutinized using the modelling approaches. The results will be used as a basis for developing forest management and conservation strategies for the Ethiopian montane forests in the face of global change.

## SEEDLING NUTRIENT RESPONSES DETERMINE TREE DISTRIBUTION PATTERNS ACROSS NUTRIENT GRADIENTS IN TROPICAL FORESTS

Delicia Pino<sup>1</sup>, Hannah Bregulla<sup>1</sup>, Ben Turner<sup>3</sup>, Richard Condit<sup>3</sup>, Björn Reineking<sup>2</sup>, Bettina Engelbrecht<sup>1,3</sup>

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<sup>3</sup>*Smithsonian Tropical Research Institute, Balboa, Panama, PA*

Identifying mechanisms that underlie tree distribution patterns in tropical forests is essential for understanding diversity patterns and for projecting consequences of climate change. We recently showed that tree distribution patterns of more than 50% of the tree species at the Isthmus of Panama are strongly associated with phosphorus and rainfall<sup>1</sup>. To elucidate the mechanisms underlying these patterns, experimental studies assessing individual species responses are needed.

If species distributions across phosphorus gradients are directly shaped by species differential phosphorus requirements, each species should outperform others in their respective home-site. Specifically, we expected that growth rates under low nutrient conditions decrease with species association to high phosphorus, and responses to fertilization increase. Moreover, growth responses should be positively related to photosynthetic responses to fertilization.

In a fertilization experiment in a low-nutrient forest site in Panama, we assessed growth responses for 32 tropical tree species with known distributions. We also measured photosynthesis for a subset of 10 species.

Overall, species exhibited only minor growth responses to fertilization suggesting that the limiting effect of nutrients on seedling growth is not very pronounced. Nevertheless, results in the second wet season of the experiment were consistent with the hypotheses. Moreover, growth responses were positively related to photosynthetic responses to fertilization. These results support that differential nutrient requirements, resulting from physiological differences in nutrient uptake or use, are directly shaping tree distribution patterns and forest composition with respect to phosphorus.

<sup>1</sup>Richard Condit, Bettina M. J. Engelbrecht, Delicia Pino, Rolando Pérez and Benjamin L. Turner (2013). Species distributions in response to individual soil nutrients and seasonal drought across a community of tropical trees. PNAS, doi:10.1073/pnas.1218042110.

**Merian Award Applicant**

WEDNESDAY 10:00



## POLLEN-BASED TEMPERATURE AND PRECIPITATION INFERENCES FOR THE MONTANE FOREST OF MT KILIMANJARO DURING THE LAST GLACIAL AND THE HOLOCENE

Lisa Schüler<sup>1,2</sup>, Andreas Hemp<sup>1</sup>, Hermann Behling<sup>2</sup>

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WEDNESDAY 10:15

The relationship between modern pollen-rain taxa and measured climate variables was explored along the elevational gradient of the southern slope of Mt Kilimanjaro, Tanzania. Pollen assemblages in 28 pollen traps positioned on 14 montane forest vegetation plots were identified and their relationship with climate variables was examined using multivariate statistical methods. Canonical correspondence analysis revealed that the mean annual temperature, mean annual precipitation and minimum temperature each account for significant fractions of the variation in pollen taxa. A training set of 107 modern pollen taxa was used to derive temperature and precipitation transfer functions based on pollen subsets using weighted-averaging-partial-least-squares (WA-PLS) techniques. The transfer functions were then applied to a fossil pollen record from the montane forest of Mt Kilimanjaro and the climate parameter estimates for the Late Glacial and the Holocene on Mt Kilimanjaro were inferred. Our results present the first quantitatively reconstructed temperature and precipitation estimates for Mt Kilimanjaro and give highly interesting insights into the past 45,000 years of climate dynamics in tropical East Africa. The climate reconstructions are consistent with the interpretation of pollen data in terms of vegetation and climate history of afro-montane forest in East Africa. Minimum temperatures above the frost line as well as increased precipitation turn out to be crucial for the development and expansion of montane forest during the Holocene. In contrast, consistently low minimum temperatures as well as about 25 % drier climate conditions prevailed during the pre LGM, which kept the montane vegetation composition in a stable state.

In prospective studies, the quantitative climate reconstruction will be improved by additional modern pollen rain data, especially from lower elevations with sub montane dry forests and colline savanna vegetation in order to extend the reference climate gradient.

**Merian Award Applicant**





## SESSION 2:

### FRAGMENTATION IN TROPICAL LANDSCAPES

[ Short title: Fragmentation in tropical landscapes ]

Chairs: Pia Parolin, Leandro V. Ferreira

Contact: pparolin@botanik.uni-hamburg.de

Fragmentation is one of the reasons for species loss, as it decreases the size of habitats and the genetic exchange between populations due to low or non-existing connectivity. Many land use forms contribute to the fragmentation of natural landscapes such as forests into smaller patches of habitat which become isolated forest islands. This has detrimental effects on the wildlife and on forest health. In wetlands which have a highly dynamic nature, habitat fragmentation may be a natural phenomenon as it occurs by the action of meandering rivers, precipitation events or sedimentation. However, nowadays fragmentation is mainly man-made, for example in reservoirs caused by the construction of hydropower dams. The present session aims at highlighting vegetation patterns and ecological processes in natural and artificial tropical forest fragments, and at discussing the effects of fragmentation in these particular ecosystems.

## DECLINING DUNG BEETLE ECOSYSTEM FUNCTIONS IN RESPONSE TO TROPICAL FOREST FRAGMENTATION

Michael Senior<sup>1</sup>, Jane Hill<sup>1</sup>

<sup>1</sup>*Department of Biology, University of York, York, UK, mjms501@york.ac.uk*

Sustainable oil palm plantations minimise impacts on biodiversity by protecting areas of High Conservation Value (HCV) in their concessions. These HCV areas tend to be forest fragments that vary greatly in size and quality. It is known that smaller and more disturbed fragments support low species richness and abundances. However, impacts on ecosystem functioning are less understood and could affect the long term viability of HCV areas. To address this we measured changes in dung beetle diversity, and rates of dung removal and horizontal secondary seed dispersal in 16 tropical forest fragments (5-3000ha) and 2 continuous forest sites in Sabah, Malaysia. Dung beetle species richness declined with fragment area, with smallest fragments supporting no more species than the oil palm itself. Rates of dung removal and horizontal secondary seed dispersal declined strongly following initial fragmentation, but showed little further change as fragment area declined. Dung removal was more robust to fragmentation than horizontal secondary seed dispersal and no horizontal secondary seed dispersal was recorded in fragments smaller than 100 ha. Overall, fragmented HCV areas are no substitute for continuous forest, but fragments larger than 100 ha can maintain some of the dung beetle species and ecosystem processes found in continuous forest.

TUESDAY 16:15



## FRAGMENTATION GENETICS OF *VATERIA INDICA*: IMPLICATIONS FOR SEED SOURCING AND FOREST RESTORATION OF AN ENDEMIC DIPTEROCARP

S.A. Ismail<sup>1,2</sup>, J. Ghazoul<sup>2</sup>, G. Ravikanth<sup>3</sup>, C.G. Kushalappa<sup>4</sup>, R. Uma Shaanker<sup>3,5</sup>, C.J. Kettle<sup>2</sup>

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<sup>5</sup>Department of Crop Physiology, University of Agricultural Sciences, Bangalore, IN

Tropical agro-forest landscapes provide repositories of tree germplasm, which have potential value for restoration of degraded forests. The Dipterocarpaceae are dominant canopy species in Southeast Asia and a vital source of timber. Little is known about how genetic diversity is maintained in dipterocarp species in human modified landscapes. This study provides a baseline for the potential of fragmented agro-forest landscapes in India to sustain forest genetic resources.

We compare genetic diversity and fine-scale spatial genetic structure (FSGS) in the threatened timber tree species *Vateria indica* within an isolated and a continuous forest site in the Western Ghats, South India. We apply parentage analysis of a range of progeny using twelve nuclear microsatellite markers to estimate pollen and seed dispersal. Using a nursery trial we evaluate effects of inbreeding on growth performance.

Our results show that levels of FSGS, and gene dispersal are comparable between a small isolated and a large continuous site of *V. indica*. Realized long-distance pollen flow into the isolated patch helps maintaining genetic diversity. We demonstrate with a nursery experiment that selection favours outbred progeny. *V. indica* has lower FSGS than another highly fragmented dipterocarps from the Seychelles, but more intense FSGS than three dipterocarp species in continuous forest in Borneo. We discuss the wider implications of our findings in the context of conservation and restoration of dipterocarp forest genetic resources in fragmented populations.

**Merian Award Applicant**

## DISAPPEARANCE OF BIRDS FROM FRAGMENTED AND SECONDARY FORESTS IN PAPUA NEW GUINEA AND THEIR PREDATION PRESSURE ON INSECT

Katerina Sam<sup>1,2</sup>, Vojtech Novotny<sup>1,2</sup>

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<sup>2</sup>*University of South Bohemia, Faculty of Sciences, Ceske Budejovice, CZ*

Tropical forests worldwide are being fragmented at a rapid rate, causing a tremendous loss of biodiversity. Thus influencing food webs and biological processes. We focused on bird communities in forest fragments (300, 600, and 1,200 ha), and adjacent secondary forests and compared them with those in continuous forest in the lowlands of Papua New Guinea. Size of forest fragments did not have a significant effect on the number of locally recorded birds, but positively influenced the number of birds present in adjacent secondary forest. We recorded 80 - 84 forest bird species in fragments, 58 - 74 in secondary forests, and 107 in continuous forest.

Large-bodied frugivores and understory insectivores were particularly sensitive to habitat fragmentation. We did not find strong support for the food scarcity hypothesis which states that the decline of insectivorous birds in forest fragments is caused by an impoverished invertebrate prey base. Neither have we found significant difference in microclimate in forest interiors. Rather, we found that microhabitats preferred by sensitive birds were scarce in forest fragments and nearly missing in secondary forests but common in continuous forest.

Further, we studied attacks by ants (and other predatory insects) and birds, as the main predators of herbivorous insects, on clay caterpillars. We exposed a total of 21 600 caterpillars, and identified 4243 predation attempts. Caterpillars exposed in primary forest were attacked significantly less often (8.9% day<sup>-1</sup>) than caterpillars in secondary forests (22% day<sup>-1</sup>). Caterpillars in fragments of primary forest suffered from higher predation (17% day<sup>-1</sup>) than those in primary forest. Caterpillars in secondary forest were attacked more by ants (15% day<sup>-1</sup>) and less by birds (6% day<sup>-1</sup>) than those in primary forest. We observed shifts in predator dominance and compensation of insect (mainly ants) for predation of insectivorous birds missing in altered habitats.

**Merian Award Applicant**



## REMOTE SENSING BASED MAPPING OF PASTURE DEGRADATION IN THE FRAGMENTED LANDSCAPE OF RIO DE JANEIRO, BRAZIL

Friederike Naegeli de Torres<sup>1</sup>, Udo Nehren<sup>2</sup>, Michael Vohland<sup>1</sup>

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<sup>2</sup>*Cologne University of Applied Sciences, Institute for Technology and Resources  
Management in the Tropics and Subtropics*

Pasture degradation is of increasing concern in many tropical and subtropical countries. Mismanagement, in particular overgrazing on steep slopes, has led to accelerated erosion processes accompanied by increased carbon emissions. Today, degraded pastures are often unprofitable and therefore offer potential for reforestation to increase carbon stocks and at the same time enhance regulating ecosystem services and contribute to biodiversity conservation. Large scale mapping of degraded pastures is thus needed to provide information for landscape planning and adaptation of national and international incentive programs. Our study aims at developing a transferable procedure for mapping pastures of different degradation stages, which is of particular importance for the selection of reforestation sites and the establishment of landscape corridors. We apply a multiple end member spectral mixture analysis on the basis of RapidEye, SPOT5 and LANDSAT 5 TM images to derive the vegetation coverage. This factor is then integrated with geomorphological criteria derived from a digital elevation model, as well as an indicator for pasture dynamics derived from a time series of RapidEye images. Results were compared with field data.

We selected our study area in the upper Guapi-Macacu watershed in the state of Rio de Janeiro. This watershed is located in the foothills of the Serra dos Órgãos mountain range, which lies within the highly fragmented and ecologically degraded Atlantic Forest biome (Mata Atlântica). In the Guapi-Macacu watershed, rainforests under various protection categories cover the steep slopes in higher altitudes, while the lower slopes and hilly foothills show a high degree of forest fragmentation. In this area pasture for cattle production is the dominating land use type. Most of these pastures show initial to advanced erosion forms, such as rills and gullies. Here we present our methodological approach and first results of the spatial analysis.

## FRAGMENTATION OF NEW ISLANDS FORMED IN RESERVOIRS IN AMAZONIA

Pia Parolin<sup>1</sup>, Leandro Ferreira<sup>2</sup>

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<sup>2</sup>*Museu Paraense Emílio Goeldi, Belém, BR*

In Amazonia, many large rivers have already been dammed or are in various stages of planning in order to provide energy from hydroelectric plants. Once dammed, rivers turn into huge lakes which flood the original vegetation in the former river basins. Mountains are left as islands in these artificial lakes. The former vegetation suffers from the strong impacts of fragmentation, including microclimatic changes (e.g., artificial edge habitats, erosion, desiccation from wind, and altered rainfall patterns) as well as effects of flooding on previously unflooded soils. These conditions lead to high mortality rates of indigenous trees unless they are pre-adapted to wet conditions and to shifts in floristic composition. We analysed plot pairs of 5 x 40 m on 17 islands of varying sizes (8-100 hectares). The plot pairs comprised one plot 30 m from the margin (= border) and one more than 100 m from the margin (= interior of the island). No significant differences of tree density, basal area, density of regeneration and canopy cover were found between island border and interior in the sampled islands in the Tucuruí dam reservoir. This gives evidence that the whole islands - and not merely the borders - are heavily affected by abiotic changes. As a consequence, there are alterations of species composition, richness and diversity, and the original species are substituted even in the central area of 100 ha islands. The responses of Amazonian vegetation fragments on such islands show that on the long run the woody vegetation is heavily affected and forests lose diversity and are shifted towards more open vegetation forms.



## SESSION 3:

### WILDFIRES AND MANAGEMENT OF TROPICAL ECOSYSTEMS IN A CHANGING WORLD

[ Short title: Wildfires and management of tropical ecosystems ]

Chairs: Dr. Joachim Schmerbeck, Daniel Kraus  
Contact: [jschmerbeck.daad@teriuniversity.ac.in](mailto:jschmerbeck.daad@teriuniversity.ac.in)

WEDNESDAY 09:15

To get insight in the newest findings on the role of fire as an ecosystem management tool under global major changes. Fire is omnipresent in almost all kinds of tropical forest and woodland ecosystems. This includes systems that faced fire since evolutionary times but also forests that have never seen fire and therefore do not have any mechanism to respond to it. In such ecosystems fires can have a severe impact and are considered by many researchers as one of the main factors determining the development of tropical forest ecosystems. In contrast, many tropical grass-dominated ecosystems are fire dependant and their ecosystem properties will undergo strong changes when fire is excluded. Fire is therefore directly linked to the provision of ecosystem services provided by these ecosystems. Climate change is expected to trigger the impact of fires on tropical ecosystems leading to a change in structure and composition as we know them today. The majority of fires in the tropics are lit by humans either accidentally or intentionally. That man sets fire to his terrestrial environment, using it as a tool to modify it into desired stages, is not new. However, the use of fire like in the increasing practice of slash and burn as well as the expected increasing vulnerability of forest ecosystems to fire under the effect of climate change, may contradict with many modern goals of society like the conservation of biological diversity and the optimization of ecosystem services in fire independent ecosystems. However, the use of fire in fire dependant ecosystems can be considered a modern and efficient management tool to maintain ecosystem properties or to prevent devastating fires in timber plantations. This session will bring players in the field of fire management in the tropics together to shed some light on the actual extent of fires in the tropics, its impact on tropical ecosystems and, most of all, direct ways of the mitigation of fire impact under the expected global changes. of contemporary and future consequences of global change on the functioning of tropical ecosystems.



## ASSESSING THE LONG-TERM ROLE OF FIRE IN THE MOUNTAIN RAINFORESTS OF LORE LINDU NATIONAL PARK, SULAWESI, INDONESIA

Siria Biagioni<sup>1</sup>, Petra Lembcke<sup>1</sup>, Hermann Behling<sup>1</sup>

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In South-east Asia, changes in the frequency and intensity of natural disturbances are expected as a consequence of global climate change, while at the same time, anthropogenic disturbance have been increasing since the start of the last century. The changing relationship between vegetation and disturbance in ecosystems such as tropical rainforests raise questions about the resilience capacity of vegetation communities and their possible future response to such events.

Mountain rainforests are sensitive to climate variability and disturbances such as natural and/or human-induced fires. Today, the main causes of wildfires in these ecosystems are related to human slash-and-burn activity and/or the opening of the forest for urban-development reasons. Natural fires, started for instance by lightning, occur in Southeast Asian rainforests, but they usually do not completely destroy the forest and merely cause the death of a few trees. However, modern observations have shown that, if lightning occurs during a period of frequent or longer than normal droughts, the rainforests become more susceptible to fire, and the frequency of fire episodes increases.

The present study aims at assessing the influence of regional- and local-scale climate changes and human disturbance on tropical mountain rainforests, with a particular focus on long-term fire regimes. Charcoal, pollen and spore analyses were carried out on sediment cores from 3 sites about 30 km apart, in the Lore Lindu National Park, Sulawesi, Indonesia. The coring sites are located at different altitudes: 1) Rorekautimbu, situated at about 2400 m a.s.l. within the upper mountain forest, 2) Lake Kalimpa at 1700 m a.s.l., within the mid-mountain forest and 3) Lake Lindu at 1000 m a.s.l., surrounded by sub-mountain forest. The three sites differ in the level of human impact, and the records span the Holocene with similar temporal resolution.

The results of the analyses were used to reconstruct the long-term changes in fire and vegetation at the sites, enabling us to assess the role of fire in these ecosystems.

**Merian Award Applicant**

WEDNESDAY 09:15



## FIRE FREQUENCY AND PLANT DIVERSITY IN TROPICAL DRY DECIDUOUS FOREST: A CASE STUDY OF KUMBHALGARH WILDLIFE SANCTUARY, INDIA

Jyoti Kashyap<sup>1</sup>, Joachim Schmerbeck<sup>1</sup>, Justus Joshua<sup>2</sup>

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<sup>2</sup>Green Future Foundation, New Delhi, IN

We assessed the impact of different fire frequency on plant community's structure and composition of a tropical dry deciduous forest in Kumbhalgarh Wildlife Sanctuary, Rajasthan, India. The result of the study shows that the frequent burning in addition to specific site conditions increases the diversity and richness of the plant species except shrubs while simplifying the structure of the vegetation.

Tropical dry deciduous forests of India are subjected to a wide range of anthropogenic pressure of which wildfires are the most important one. Wildfires act as a driver for variety of temporal and spatial changes in the ecosystem. Despite having a significant role in altering various ecosystems, there is no comprehensive data on the different dimensions of fire in India. Using a combination of remote sensing and GIS techniques, three fire frequencies [no fire (0 fires in 12 years), low fire (1-3 fires) and high fire (4-7 fires)] were extracted from 12 years Landsat data (1999-2011). A total of 60 vegetation plots were laid representing no fire and high fire frequencies on homogeneous site conditions of slope (10° to 20° and >20°) and aspect (North and South). Data regarding the number of plant species and species cover of all the life forms was collected. MRPP (Multiple Response Permutation Procedure) shows that the diversity of trees, grasses and herbs were positively correlated to high fire frequency especially at north aspect but no significant difference was found for the shrub layer on both aspects. The average tree dbh (diameter at breast height) did not differ significantly between the two fire frequencies but smaller dbh classes were found to be less in frequent burnt areas and at southern aspects. Frequently burned spots showed a significant lower plant cover in the middle layer as compared to no fire areas ( $p < 0.001$ ). Frequent fires trigger the number of seedlings while those species are not represented in the middle and canopy layer in both the aspects. We conclude that fire frequency with specific site conditions supports plant diversity in the lower layer for a short time period but it is likely to hamper tree diversity over long time as it selects only fire resistant tree species. The development of plant diversity over longer time periods under the absence of fire is not known but is seen as essential for fire management.

WEDNESDAY 09:30

## FILTERS TO TROPICAL MONTANE FOREST REGENERATION AFTER FIRE

Denis Lippok<sup>1</sup>, Matthias Schleuning<sup>1,2</sup>, Isabell Hensen<sup>1,3</sup>

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Tropical forests are deforested and fragmented at large spatial scales. Associated with the loss of forest habitats is the loss of biodiversity and ecosystem service supply. Strong filters in deforested habitats slow down or even inhibit forest regeneration. Seed input from adjacent forest remnants into deforested habitats is low and environmental conditions are unsuitable for the establishment of forest species. Bracken fern (*Pteridium* spp.) invades frequently burned sites and competes with regenerating vegetation. While natural forest regeneration is well studied in tropical lowlands, montane forest regeneration received comparably less attention. Elevation as a driving factor for forest regeneration is often neglected, although studies on elevation gradients reveal important predictions of the effects of climate change.

We investigated filters to tropical montane forest regeneration in deforested, frequently burned habitats in a fragmented landscape in the Bolivian Andes. Here, we summarize the results of three studies. In the first study, we assessed soil seed banks. In the second study, we investigated environmental conditions (i.e. microclimate and soil properties) and established woody vegetation and in the third study we studied the first year of post-fire regeneration.

We identified two main filters to tropical montane forest regeneration in deforested habitats: (I) Low seed input from adjacent forests with dispersal distances mostly below 20 m and (II) hot and dry microclimates and frequent fires. Effects associated with climate change, such as increasing temperatures, prolonged droughts and more frequent fires, will most likely exacerbate these filters. Additional management, such as the control of fires and the manual introduction of forest species will be required to enhance forest regeneration and to recuperate biodiversity and ecosystem service supply in fragmented landscapes.

**Merian Award Applicant**

WEDNESDAY 09:45



## WILD LAND FIRES AND THE SUPPLY OF ECOSYSTEM SERVICES: CONSEQUENCES AND PERSPECTIVES FOR INDIAN TROPICAL DRY FORESTS

Peter Fiener<sup>2</sup>, Joachim Schmerbeck<sup>1</sup>

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WEDNESDAY 10:00

The main objective of this review is to contribute to the understanding of the inter-linkage between wild fire in Indian TDF and ecosystem services (ES). Three groups of ES and their relation to wild fires were analysed: forest provisioning services, water related services, and effects on biodiversity. Our review revealed that fire serves the utilisation of many provisioning services while it enhances erosion and hampers the capacity of TDF's to regulate water. Fire has a strong impact on biodiversity but the quality of this impact depends very much on the taxa in focus.

Tropical dry forest (TDF) cover approximately 146 000 km<sup>2</sup> (4.4%) of the Indian Territory, whereas annually fire is detected via the MODIS 1 x 1 km fire product on an average area of 2030 km<sup>2</sup> (1.4% of TDF). These fires are largely intentionally lit mainly with the aim to alter the vegetation in order to gain specific services and goods. We firstly reviewed wild fire effects on these ESs as given in studies carried out in other (dry) forest areas of the world as systematic studies on fire affected ESs are missing in India. Secondly, we discussed the findings from the review in the context of the Indian situation. India has an extremely wide range of forest provisioning services directly related to wildfires. Regarding the water related ecosystem services we found that the most important effects of regular forest fires in India are a slow degradation the forest ecosystems and a degradation of associated soils. The potential of these forests in regulating hydrological cycle's in the absence of fire can be expected to be above the actual status. A general judgment on the effect of fire on biodiversity levels is impossible as this depends on the community and species in focus. Consequently, forest managers need a sound knowledge regarding the interplay of wildfires and ecosystem behavior in general, and more specifically regarding the effects on any taxa in focus of a conservation effort. Much more research is needed regarding the trade-offs between provisioning services and services, like water regulation and biodiversity, as the effects of wildfires on those potentially off-set short-term benefits of forest provisioning services.

## NEW ONLINE FIRE MONITORING TOOL FOR CONSERVATION

Ilaria Palumbo<sup>1</sup>

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Fires are central in the ecology of tropical ecosystems and can act as a threat or a regenerating factor depending on the ecosystem adaptations to it. Many ecosystems in the world are fire-dependent and for them fire is essential to maintain their functionalities and their biodiversity.

Park managers need up-to-date information on fire occurrence for their daily activities and longer-term planning. Nowadays Earth Observation (EO) provides reliable data on fire activity worldwide, however satellite data require processing and analysis capacity, which are not always accessible to park managers.

In order to overcome this limitation we developed an on-line fire monitoring system which presents satellite-based information on fire location and burned area extent as environmental indicators and maps that do not require specific software or further processing to be used. The tool provides near-real time data and covers more than ten years from late 2000 to the present day, at global level. This information can assist park managers in their conservation programs, the design and implementation of fire plans, and the control of human induced threats and pressures, as many illegal activities like poaching are often associated with fire. The availability of a long time series of fire data allows the detection of alterations of the fire regimes in the natural habitats. In forest ecosystems, for example, fire occurrence can be used as a proxy for conservation effectiveness.

The tool uses web services developed at the JRC to provide historical and near-real time information of the fire activity derived from the satellite-borne Moderate Resolution Imaging Spectro-radiometer (MODIS) fire products. These are distributed by NASA-FIRMS and the University of Maryland. The tool includes all the protected areas listed in the World Database on Protected Areas (United Nations Environment Programme, World Conservation Monitoring Centre - UNEP-WCMC).

WEDNESDAY 10:15



## SESSION 4:

### GEOINFORMATICS FOR TROPICAL ECOSYSTEMS - TOOLS FOR CONSERVATION AND MANAGEMENT

[ Short title: Geoinformatics for tropical ecosystems ]

Chairs: Prof. P K Joshi, Dr. J Schmerbeck, Dr. C.P. Gross

Contact: pkjoshi@teri.res.in

WEDNESDAY 11:00

To identify efficient GIS tools and methods for conservation of tropical forest ecosystems in different geographic locations. Understanding the complex structure and function of tropical ecosystems necessitates synergetic adoption of measurement tools at plot level inventories as well as spatio- temporal database on the dynamics of this ecosystems. To achieve this, importance of geoinformatics - essentially a combination of tools such as Geographic Information System (GIS), satellite remote sensing, Global Positioning System (GPS), and information and communication technologies (ICT), are realized as complimentary systems to field-based studies. This proposed session would addresses how a wide range of geospatial tools can be used in assessing, monitoring and management of landscape in tropical ecosystems. The discourses and presentations would cover landscape ecological application tools, and the required data from broad spatial extents that cannot be collected through field-based methods. Remote sensing data and techniques address these needs, which include identifying and detailing the biophysical characteristics of species' habitats, predicting the distribution of species and spatial variability in species richness, and detecting natural and human-caused changes at scales ranging from individual landscapes to the tropics. We plan to invite experts from different geographic regions to discuss the innovative approaches in respective countries to regulate biodiversity on different spatial and temporal scales in terms of natural and anthropogenic impacts, and the effects, responses, and indicators in terms of structure and function. Additionally, we would also look into the future plans and newer approaches in terms of requirements and adoption of these technologies. The broad areas to be covered are: - Mapping and monitoring of Biodiversity - Landscape characterization and analysis - Protected area management including corridor - Wildlife habitat characterization and modeling - Tree cover/species/crown identification and mapping - Tool for the assessment and valuation of ecosystem services - Assessment of ecosystem disturbance and dynamics - Combination of insitu data, remote sensing, GPS and GIS.

## PREDICTION OF FOREST STRUCTURE PARAMETERS IN A TROPICAL DRY FOREST IN THE SOUTHWEST OF MADAGASCAR USING REMOTE SENSING IMAGERY

Daniel Kübler<sup>1</sup>

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Assessing and monitoring aboveground tree biomass and forest structure parameters is an important part of sustainable forest and landscape management, and paramount for the implementation of international schemes for forest protection such as REDD+. However, the acquisition of this information is difficult and resource-intensive for the majority of remote forest areas of many tropical developing countries. This holds especially true in areas of tropical dry forests as these are characterized by scattered canopies with oftentimes little leaf areas and unevenly distributed structure parameters. In this study, we evaluated to what extent remote-sensing data can be used to estimate forest parameters of the Tsimanampetsotsa National Park in the southwest of Madagascar by creating simple linear regression models between the remote-sensing data and in-situ ground data.

Remote sensing datasets were generated from scenes from Landsat ETM+, SPOT 5 and Pleiades sensors. Three different vegetation indices were derived for each sensor. Additionally, texture variables, which express the spatial variation of the different image elements, were computed for individual raster bands and vegetation indices. In-situ ground data consisted of forest structure parameters (basal area, crown cover, species richness), which were derived from 80 0.1-ha forest inventory plots located within the national park.

Simple linear regressions between crown cover and individual remote sensing variables achieved better maximum coefficients of determination than models for species richness and basal area. Crown cover and species richness were better described by variables derived from the SPOT 5 sensor, whereas basal area produced better models with data derived from the Landsat ETM+ sensor.

Those remote sensing variables that displayed strongest correlations with in-situ ground data were then used to create pixel-wise predictions of forest structure parameters for the area of the national park using a partial least squares (PLS) regression approach.

**Merian Award Applicant**

WEDNESDAY 11:00



## COUPLING SOCIO-ECONOMIC FACTORS AND ECO-HYDROLOGICAL PROCESSES USING A CASCADE-MODELING APPROACH

Vincent Odongo<sup>1</sup>, Mulatu Dawit<sup>1</sup>

<sup>1</sup>*University of Twente, Faculty of Geoinformation Science & Earth Observation (ITC), Enschede, NL*

WEDNESDAY 11:15

Most hydrological studies do not account for the socio-economic influences on eco-hydrological processes. However, socio-economic developments often change the water balance substantially and are highly relevant in understanding changes in hydrological responses. In this study a multi-disciplinary approach was used to study the cascading impacts of socio-economic drivers of land use and land cover (LULC) changes on the eco-hydrological regime of the Lake Naivasha basin. The basin has recently experienced substantial LULC changes exacerbated by socio-economic drivers. The simplified cascade models provided insights for an improved understanding of the socio-ecohydrological system. Results show that the upstream population has transformed LULC such that runoff during the period 1986-2010 was 32% higher than during the period 1961-1985. Cut-flower export volumes and downstream population growth explain 71% of the water abstracted from Lake Naivasha. The influence of upstream population on LULC and upstream hydrological processes explained 59% and 30% of the variance in lake storage volumes and sediment yield respectively. The downstream LULC changes had significant impact on large wild herbivore mammal species on the fringe zone of the lake. This study shows that, in cases where observed socio-economic developments are substantial, the use of a cascade-modeling approach, that couple socio-economic factors to eco-hydrological processes, can greatly improve our understanding of the eco-hydrological processes of a catchment.



## SPECTRAL VARIATION EXPLAINS HIGHER VARIANCE IN PLANT $\beta$ -DIVERSITY THAN SPATIAL-AUTOCORRELATION

Francis Muthoni<sup>1</sup>, Thomas Groen<sup>1</sup>, Andrew Skidmore<sup>1</sup>, Bert A.G.<sup>1</sup>

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Most ecosystems lack long-term extensive data that can support understanding or predictions of what determines their inherent biodiversity patterns. The spectral variation hypothesis (SVH) suggests that the between-plot spectral variation is a proxy for environmental heterogeneity and therefore can act as an indicator of plant beta-diversity. We evaluate the variance in plant beta-diversity as explained by the spectral variation of Landsat-TM data (as a proxy for environmental variation) and spatial autocorrelation in a fragmented riparian landscape. We use Mantel correlograms to investigate the presence and the structure of spatial dependency in beta-diversity and spectral distances. The spatial lag-distance classes from mantel correlograms that had significant spatial autocorrelation in beta-diversity and spectral distances were used as spatial descriptors. We fitted a PLSR model with the plant beta-diversity as response and the Euclidean distances of spectral and spatial lag-distances classes as predictors. We partition variances due to pure spectral, spatial dependency in spectral distances and purely spatial autocorrelation. Mantel correlograms revealed significant spatial autocorrelation in beta-diversity and spectral distances and an exponentially decaying correlation between beta-diversity and spectral distances. This suggested that both spatial and spectral distances contributed significantly to beta-diversity in the landscape. The PLSR model explained 37% of total variance in beta-diversity. Combination of the proportion of total variance explained purely by spectral distances (30%) and spatially dependent spectral variation (36%) revealed that environmental (spectral) distances explained higher variance in beta-diversity (66) than purely spatial autocorrelation (34%). Results support both niche and dispersal assembly in determining beta-diversity patterns in this landscape, suggesting that conservation initiatives should aim at enhancing habitat diversity and increasing the abundance of individual species.

**Key Words:** dispersal assembly, Mantel correlograms, niche assembly, neutral theory of biodiversity, spatial autocorrelation, spectral variation hypothesis

**Merian Award Applicant**

WEDNESDAY 11:30



## APPLICATION OF GIS AND REMOTE SENSING ON ASSESSMENT OF LAND USE/LAND COVER CHANGES IN BAC KAN PROVINCE, NORTHERN VIETNAM DURING THE PERIOD 2000-2010

Nguyen Mai Phuong<sup>1</sup>

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Since the reform in 1986, Vietnam has witnessed remarkable changes in land use/land cover related to reforestation and forest protection programs, land management policies and so on. These changes, which have been affecting to ecological environment, livelihoods and society, are baseline for development and planning activities. Thus, there is an urgent need to update the state of land transform, especially in Bac Kan, one of the poorest province in Vietnam, to enhance the quality of livelihoods as well as environment conservation. GIS technique with the support of satellite imagery (LANDSAT) in every five years 2000, 2005, 2010 are powerful tools to assess the dynamic of land use and land cover in the province. During the past ten years, forests have experienced the most remarkable changes from 51% of province area in 2000 to 63% of the number in 2010. Both natural forest and planted forest have been growing, but planted forest rose dramatically from 10,630 hectares to 38,814 hectares in 2010. Agriculture with cropland and perennial crops maintain the small area of 7% of province area while bare land reduced from 39% of the area 1990 to 27% of the number after ten years. Using planning land use map of the province, the trend of land use/land cover changes can be projected for the next ten year period. By estimating the changes towards 2020, it is recommended that although forest cover in Bac Kan continues increasing but an option to achieve better livelihood should be considered. Moreover, by overlaying planning map on 2010 land use map, it can be seen clearly that there is a probability of 0.4 (40%) of natural forest converted to planted forest and other land use types, which can threaten the environmental sustainability and biodiversity conservation

**Merian Award Applicant**

WEDNESDAY 11:45

## COMBINED BIOMASS INVENTORY IN THE SCOPE OF REDD+ (REDUCING EMISSIONS FROM DEFORESTATION AND FOREST DEGRADATION)

Daniel Plugge<sup>1</sup>, Thomas Baldauf<sup>2</sup>, Michael Köhl<sup>1</sup>

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<sup>2</sup>Thünen Institut WF, Hamburg, DE

A reliable framework for measuring, reporting and verification is urgently needed to ensure the integrity and credibility of REDD+ efforts in general and REDD+ as a part of the forthcoming new climate agreement which is assumed to be established in Paris in 2015. This presentation features an approach for combined biomass inventories in the scope of a REDD+ regime. The focus is set on a sound and reliable method for measuring and monitoring the current state of carbon stocks and their changes over time. The approach was developed and successfully implemented in three different forest formations (tropical wet, tropical deciduous and tropical dry) in Madagascar. It combines a multi-temporal remote sensing approach incorporating satellite sensors from medium to very high resolution with a terrestrial cluster sampling design, which proved to be operational for the whole spectrum from highly fragmented to pristine forest areas. This combination was implemented by a multi-phase sampling approach. The inventory is designed for the prerequisites of a continuous forest inventory (CFI) to facilitate the quantification of possible CO<sub>2</sub> reductions over time. The first inventory field-assessments were accomplished during the project, and resulted in estimates of carbon stocks. Statistical upscaling procedures were utilised to aggregate these estimates to several levels. The results of the introduced methodology will be presented and discussed.

**Merian Award Applicant**

WEDNESDAY 12:00



## MAPPING LEAF AREA INDEX (LAI) - DERIVING LAI MAPS FROM REMOTE SENSING DATA AND VISUALIZING MAP UNCERTAINTIES

Philip Beckschäfer<sup>1</sup>, Lutz Fehrmann<sup>1</sup>, Rhett D. Harrison<sup>2</sup>, Jianchu Xu<sup>2</sup>, Christoph Kleinn<sup>1</sup>

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<sup>2</sup>*World Agroforestry Center, ICRAF-Kunming Office, Kunming, CN*

WEDNESDAY 12:15

Leaf surface area, often quantified by the Leaf area index (LAI), is an indicator for vegetation density and condition of an ecosystem. As leaf surface area relates to plant physiological processes, such as, photosynthesis, transpiration, carbon and nutrient cycle, the LAI is moreover a key input to many climate and ecological models. Satellite remote sensing provides means to model the distribution of LAI values over large and remote areas, producing maps considered relevant to the understanding of larger area ecosystem processes. In this study, the potential of RapidEye satellite imagery, optimized towards vegetation analyses, to predict LAI values is investigated for a landscape in the uplands of Xishuangbanna, Yunnan, China which is characterized by a disturbance gradient ranging from shrub land to mature mountain rainforest. For predictive mapping of LAI a *randomForest* model is used with 59 image features derived from RapidEye data as explanatory variables: 6 vegetation indices, 16 texture indices calculated at 3 spatial scales and 5 genuine spectral image bands. 252 field observations of LAI derived with hemispherical photographs are used as ground reference. Boruta analysis showed that only 22 of the image features are relevant for predicting LAI. Among these vegetation indices were particularly important, but significantly higher map accuracies are achieved if texture features are used in the modelling as well. In order to illustrate the uncertainties of the LAI map, a second map is provided which depicts the spatial distribution of the goodness of fit of the model – quantified by the mean absolute error (MAE). From this “uncertainty map” an area weighted MAE = 0.35 is calculated and compared to the unweighted MAE of 0.29.

**Merian Award Applicant**

## ESTIMATING FOREST BIOMASS: BETWEEN HEAVENLY GLOBAL PRODUCTS AND THE DEVIL IN THE DETAIL

Christoph Kleinn<sup>1</sup>

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Biomass is among those forest attributes that have attracted much attention over the past years, in particular in the context of the role of forests as carbon sink and source and as significant home to terrestrial biodiversity. The Intergovernmental Panel on Climate Change IPCC distinguishes five forest carbon pools that need to be reported by the signatory parties to UN-FCCC: (1) above ground biomass (AGB), (2) below ground biomass, (3) dead wood, (4) litter and (5) soil organic carbon. Many studies focus on AGB not only because it is more directly accessible for observations but also because it is the pool that exhibits the largest potential short term changes.

While various global and regional products have been published over the past years presenting global maps of forest AGB, observation of forest biomass remains notoriously difficult. Many detail questions in particular regarding field observations of AGB are still to be clarified; and these field observations are eventually the reference for all remote sensing based large area AGB products.

In this paper, we discuss the observation process of forest AGB, address error sources and their potential role for larger area estimation, present results of own studies and identify detail questions that require to be more intensively researched in order to also improve large area biomass estimation. It is also a call to critically analyse all details of AGB estimation methodologies in order to better understand the quality of large area forest AGB products.

WEDNESDAY 14:45



## CLASSIFYING LAND USE/LAND COVERS IN MUNESSA-SHASHEMENE LANDSCAPE OF THE ETHIOPIAN HIGHLANDS USING MONO-TEMPORAL RAPIDEYE IMAGE

Mengistie Kindu<sup>1</sup>, Thomas Schneider<sup>1</sup>, Demel Teketay<sup>2</sup>, Thomas Knoke<sup>1</sup>

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<sup>2</sup>*Botswana College of Agriculture, Department of Crop Science and Production, Gaborone, BW*

WEDNESDAY 15:00

Knowledge of land use/land cover (LULC) is a key factor as an input for a variety of applications, ranging from monitoring global to local change effects, like extent and rate of tropical forest conversions in different locations. However, the success of mapping this resource differs depending on method of classification, type of image and nature of landscape used for analysis. The objective of this research was to evaluate the accuracy of classifying land use/land cover resources from a mono-temporal image taking Munessa-Shashemene landscape of the Ethiopian highlands as a case study site. RapidEye image of February 2012 was used. The image was classified using object based image classification technique. Nine LULCs were successfully captured and the accuracy of classified image was assessed. The classification result reveals an overall accuracy of 93.2% with Kappa statistic of 0.924. Our producer's and user's accuracies for bare lands, croplands, grasslands and settlements (user's accuracy) ranged from 80.4% to 94%. On the other hand, the natural forests, woodlands, plantation forests, tree patches, and water classes show higher producer's and user's accuracies of above 96%. Such classification accuracies with mono-temporal image were achieved by using the advantage of applying object-based classification techniques, which allow integration of different object features, such as spectral values, shape, and texture. The land use/land cover map produced with higher overall accuracy can be used during land use planning process, for rehabilitation campaign, or for targeting forest conservation areas of the case study site. In addition, the object based approach used for this analysis has the potential to be extended across other tropical area with similar landscape features for improved classification.

## BIOCLIMATIC NICHES OF ENDEMIC IXORA SPECIES ON THE PHILIPPINES: POTENTIAL THREATS BY CLIMATE CHANGE

Cecilia Banag<sup>1,2,4</sup>, Timothy Thrippleton<sup>3</sup>, Grecebio Jonathan Alejandro<sup>1,2</sup>, Björn Reiniking<sup>3</sup>, Sigrid Liede-Schumann<sup>4</sup>

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Information about bioclimatic niches of endemic species is of great importance for decision-makers to set appropriate targets for conservation and future research. The objectives of this study were to establish baseline information about the climatic niches of *Ixora* species endemic to the Philippines and to identify suitable areas and potential range shifts under future climate conditions. For analyzing and modeling species distributions, a set of 19 bioclimatic variables from the WorldClim database was considered. Analysis of the endemic species and their relationships with the bioclimatic variables showed that mean annual temperature, mean annual precipitation and their relationship with seasonality are the biggest contributing factors for the distributions of endemic species of *Ixora* in the Philippines. Species distribution modeling was carried out using the model MAXENT for the two endemic species *I. bartlingii* and *I. auriculata*. In regard to future distribution of the two *Ixora* species, model results suggest that their geographic distributions will shrink under predicted levels of climate change for the scenarios B2 and A2.

**Merian Award Applicant**

WEDNESDAY 15:15



## FOREST BURNED AREA MAPPING IN SOUTHERN ECUADOR USING MONO-TEMPORAL RAPID EYE IMAGERY AND OBJECT BASED IMAGE ANALYSIS

Nicolás Corti<sup>1</sup>, Mengistie Kindu<sup>1</sup>, Thomas Schneider<sup>1</sup>, Thomas Knoke<sup>1</sup>

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WEDNESDAY 16:00

Fires are one of the most important hazards that threats tropical forests in South America. Research shows the drivers that trigger fires are usually population growth and its demand of food and energy, logging, road construction, agricultural expansion, among others. The identified drivers in southern Ecuador are not completely different from the South American ones. The Ecuadorian economic system relies on the sustainable exploitation of natural resources and in order to convert primary forests into agricultural land, farmers make extensive use of fire. In order to regulate and control fires qualified human resources, firefighting infrastructure and funding are needed. However, information is the most important element within the analysis of fires and its availability is extremely necessary for taking the most appropriate management decisions and actions. Southern Ecuador has a lack of fire information which is urgently needed for land management purposes. In this context, this study concentrates in testing the quality of Rapid Eye imagery to map forest burned areas. Mono-temporal Rapid Eye imagery is analysed in an object based classification environment. The result is obtained after detecting the burned areas, and classifying the land use land cover. The research proposes a new classification approach to determine the time of burn as well as to discriminate forest burned areas using a single mono-temporal image. The results showed the high suitability of Rapid Eye to map burned areas (Overall Accuracy 99.1%). Besides, old and recently burned areas can be differentiated by analysing the vegetation cover and charcoal deposition. Finally, Object Based Image Analysis (OBIA) proved to be a powerful tool for detecting forest burned areas in mono-temporal data.



## COMPARISON OF SEVEN NEW FOREST INVENTORY PLOTS AND FIRST EXPERIENCES WITH REMOTELY CONTROLLED AERIAL VEHICLES

Fabian Enßle<sup>1</sup>, Jörg Haarpaintner<sup>2</sup>, Pawan Datta<sup>1</sup>, Miguel Kohling<sup>2</sup>, André Mazinga<sup>3</sup>, Landing Mane<sup>3</sup>, Barbara Koch<sup>1</sup>

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<sup>2</sup>Northern Research Institute, Tromsø, NO

<sup>3</sup>Observatoire Satellital des Forêts d'Afrique Centrale, Kinshasa, CD

Estimation of woody biomass by remotely sensed data remains a challenging task in remote tropical areas. Ground reference data is often sparse and the diversity of tree species is very high. For a field campaign within the framework of ReCover project, the primary objective was to map land cover and forest above ground biomass (AGB). During two weeks seven new forest inventory plots were established. Within a square area of 20m by 20m all trees with a diameter at breast height (DBH) of 10cm or more were sampled. Tree species and each specific DBH were collected for all stems inside the plot. Overall 267 trees and 58 different species could be successfully identified by a local expert. Out of these 58 species, 32 were found in the wood density database, which was created by Chave et al. (2009). For all other tree species we assigned the mean value of the known densities. Finally we used two different methods to estimate AGB. First method is based on the IPCC good practice guidance for LULUCF and the second method is based on Feldpausch et al. (2012). The difference between these methods ranges from 3 tons/ha up to 85 tons/ha highlighting on one hand the satisfactory performance of these methods, and at the same time underlining the complexity of AGB estimation in the region. Additional to the forest inventory plots several flights with a remotely controlled quadrocopter with a digital camera equipped were performed. By using the digital images as input for further processing in an image matching software, a three dimensional representation of the forest canopy structure was successfully computed. Further analyses of these digital surface models will help to analyze canopy structure and canopy density.

WEDNESDAY 16:15



## SESSION 5:

### STRATEGIES TO CONSERVE TROPICAL FOREST ECOSYSTEMS

[ Short title: Strategies to conserve tropical forest ecosystems ]

Chair: Prof. Dr. Thomas Knoke

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WEDNESDAY 11:00

Growing environmental, economic and social challenges are connected with the world's continuing loss of extensive tropical forests areas to satisfy the still growing demand for mainly agricultural land. Increasing populations and continuously changing diets towards meat and other energy-rich products result in increasing food demand, while the food production systems since long impact adversely on the environment. A growing trend to produce energy from food further heats up the already strong competition for land and water, escalating in the phenomenon of "land grabbing". And finally poverty and rural depopulation are undesirable social consequences of inefficient land-use systems and forest loss, which may partly be traced back to insufficient knowledge, lacking citizenship and education. This multifaceted situation has created a manifold of approaches to ensure the preservation of tropical forests and to achieve the sustainable use of our planet's resources. Approaches aim to satisfy growing demands for food, food security, water, and energy, and this without destroying tropical forest ecosystems. They include "designer landscapes", agroforestry approaches, "land-sparing" and "land-sharing" models, as well as combinations based on the "compartmental land use approach". However, economic considerations, which are important for the implementation of the conservation concepts, are often excluded. Really convincing solutions to reconcile the preservation of tropical forests with growing demands for resources are scarce. Thus, the session seeks contributions combining conservation strategies with improved land-use efficiency and economic considerations.

## REDUCING FINANCIAL RISKS OF REFORESTATION BY PRODUCT DIVERSIFICATION - AN AGROFORESTRY APPROACH

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The need for reforestation of degraded tropical lands to recover their ecological services is widely acknowledged. However, the practical implementation of reforestation on farms is often hindered by two apparent obstacles: The long time interval - of up to fifteen years - until the first revenues from wood harvesting can be expected and the inherent uncertainties related to these future wood prices and yields, which often discourage landowners. In the present study we investigated the potential of sequential intercropping of hardwood plantations with food crops to 1) provide positive Net Cash Flows during the first years after tree planting and 2) to reduce the dependency of the farm income (defined as the Net Present Value of the entire rotation) on uncertain wood prices. For this purpose, we analyzed tree and crop yields, production costs and producer prices observed in an agroforestry trial in the East of Panama, using different native and exotic tree species combined with common staple food crops such as maize, beans and pigeon pea. Monte Carlo simulation was then used to incorporate uncertainties based on historic price and yield fluctuations. The results suggest that management costs of both, the tree and crop component could be offset during the first years by selling agricultural products. Consequently, the expected Net Present Value (NPV) of the agroforestry system calculated over the entire rotation period of 25 years exceeded the NPV of the pure forest plantation. Intercropping was also found to effectively reduce the dependence of the reforestation's profitability on future wood prices, even if intercropping was only carried out during the first two to four years. Therefore, this study demonstrates the importance of product diversification to reduce financial risks of forest plantations and consequently, to turn reforestation into a more attractive land-use option. Intercropping hardwood plantations might furthermore offer an important tool to reconcile the ecological restoration of degraded lands with food production in rural areas.

**Merian Award Applicant**

WEDNESDAY 11:00



## GALLERY FORESTS OF KENYA: LAND USE MEETS CONSERVATION

Christin Busch<sup>3</sup>, Michelle Horn<sup>1</sup>, Jana Igl<sup>1</sup>, Janika Kerner<sup>1</sup>, Anke Müller<sup>1</sup>, Christina Fischer<sup>1</sup>, Mike Teucher<sup>2</sup>, Jan Habel<sup>1</sup>

<sup>1</sup>Technische Universität München, München, DE

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WEDNESDAY 11:15

The river basins are important lifelines in the dry rural lowlands over major parts of East Africa. These river valleys with their gallery forests are important habitats for many endangered plant and animal species. Furthermore these gallery forests provide essential ecosystem services for the human beings (ground water, fertile soil, etc.) living along these streams. Population ecology analyses on representatives of these river gallery forests (as the Kenya-endemic Hinde's Babbler, *Turdoides hindei*) in combination with detailed land-use mapping give information on (i) potential changes from the past, intact and interconnected into highly degraded forest fragments, (ii) recent situation for the persistence of species living in these today highly fragmented gallery forests, and (iii) future trends and potential solutions how to conserve this forest habitat, and safeguarding biodiversity and life quality for the local human population.

**Merian Award Applicant**

## STRATEGIES FOR BIODIVERSITY CONSERVATION IN OIL PALM PLANTATIONS

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Oil palm plantations are expanding across the tropics, causing declines in many species. However, palm oil is a key income source and a useful material. Identifying strategies that retain biodiversity within these plantations is therefore important if we are to mitigate the negative impacts of this crop on biodiversity and ecosystem services.

One strategy for maintaining biodiversity in tropical agricultural landscapes is the protection of vegetation along river banks (riparian reserves). Whilst this vegetation is primarily kept for its positive impact on water quality and hydrological dynamics, it can also provide valuable non-crop habitat. We assessed the extent to which riparian reserves can support biodiversity comparable to riverside areas in unconverted forest. We also compared the fauna retained in the reserves to that in areas where no riparian vegetation remains (i.e. oil palm is planted up to the edge of the river).

We surveyed two insect indicator groups (ants and dung beetles) and their ecological functions in riparian areas within oil palm plantations and riparian areas in logged forest. All our field sites were based in Sabah, Malaysian Borneo.

We found that riparian forest buffer zones support terrestrial forest-dependent species, but their conservation value is dependent on several landscape level variables. In particular, our data suggest that the existing legal requirements for reserve width and connectivity are not sufficient. Our research can help to refine management protocols for oil palm in order to conserve biodiversity and ecosystem function.

WEDNESDAY 11:30



## LOW CONSERVATION VALUE OF OIL PALM AGRICULTURE FOR THE HERPETOFAUNA OF SOUTHERN COSTA RICA

Nina Gallmetzer<sup>1</sup>, Christian H. Schulze<sup>1</sup>

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Habitat loss and fragmentation due to land use are widely recognized to be the major driving forces of global biodiversity loss. We quantified the effects of oil palm cultivation on the herpetofauna of the Pacific lowlands of Costa Rica, one of the most diverse countries in the world. Therefore, diurnal and nocturnal amphibians and reptiles as well as several habitat variables (vegetation characteristics, leaf litter cover, dead wood amount) were assessed between July and September 2013 at forest interior (FI), forest margin (FM) and oil palm plantations (OP) (N = 5 replicate sites per habitat) in vicinity of the Tropical Research Station La Gamba. At each study site the herpetofauna was sampled 9-10 times along two 100 m transects. In total 29 amphibians (569 individuals) and 19 reptile species (261 individuals) were recorded. The herpetofauna richness decreased dramatically from forest habitats (total of 35 and 33 species recorded at FI and FM sites, respectively) towards oil palm plantations (18 species). The latter habitat was also characterized by a distinct species assemblage, dominated by mostly widespread species tolerant against human disturbance. The low structural diversity of oil palm plantations may have the strongest negative impact on the herpetofauna. For example, the mean leaf litter cover ( $\pm$  SD) decreased dramatically from FI ( $61 \pm 17\%$ ) and FM sites ( $69 \pm 17\%$ ) towards OP sites ( $1 \pm 1\%$ ) corresponding to a significant decline of richness and abundance of leaf litter species in our study area. While at both FI and FM sites a total of 8 leaf litter dwelling species (FI: 40 individuals, FM: 62 individuals) were recorded, only 3 species (3 individuals) were found at OP sites. Our results indicate a similar negative impact of oil palm cultivation on tropical biodiversity as already reported for South East Asia.

**Merian Award Applicant**

WEDNESDAY 11:45

## **SOCIO-ECONOMIC CHARACTERISTICS OF MANGUZI TRADITIONAL COMMUNITY AS A PRE-REQUISITE FOR CONSERVATION, RESTORATION AND WISE USE OF WETLANDS**

Naret Guerrero Moreno<sup>1</sup>, Johannes Kollmann<sup>1</sup>, Jan Sliva<sup>1</sup>, Dianne Scott<sup>2</sup>

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The South African part of Maputaland Coastal Plain contains the most extensive and biodiverse wetlands, which in turn host the best developed peat deposits in the whole country. These subtropical wetlands, especially peatlands, are the location of subsistence farming activities for the traditional Tembe community in Manguzi, South Africa, due to the lack of other suitable land for farming. The Manguzi population is growing rapidly; which in turn increases the pressure on the limited local wetlands for crop production through unsustainable farming practices, and also jeopardizes the availability of basic services and job opportunities. Our study is focusing on the conservation, restoration and wise use of the Manguzi wetlands. During a period of two months in 2013, a survey of 65 farmers and 20 interviews were carried out to study the socio-economic characteristics of the peat farmers, the importance and value of peatlands for the local people, and the relationship between their livelihoods and the natural environment. A socio-economic profile of households farming on wetlands reveals that most of the households are female-headed, consist of 6 - 10 people, have no or a low level of education, and live in poverty. The wetlands possess traditional and other values besides farming for local people. Local farmers report the rapid degradation of the wetlands in the past ten years. The thorough understanding of socio-economic characteristics of traditional farming communities is a necessary pre-condition for nature conservation in Manguzi. These results will be used for the further planning of conservation, restoration and wise use of wetlands in the area.

WEDNESDAY 12:00



## HUMAN RESOURCE USE AND PROTECTION AT CHATTHIN WILDLIFE SANCTUARY, A PROTECTED DRY TROPICAL FOREST IN MYANMAR

Melissa Songer<sup>1</sup>, Myint Aung<sup>2</sup>, Khaing Khaing Swe<sup>2</sup>, Ruth DeFries<sup>3</sup>, Peter Leimgruber<sup>1</sup>

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<sup>3</sup>Columbia University, New York, NY, US

WEDNESDAY 12:15

Dry deciduous forests are a highly threatened and little protected type of tropical forest. They are often in close association with areas of high human population densities, resulting in higher extraction pressures compared to other forest types. Even in protected areas where forest conversion is curtailed, subsistence use of forest products continues, particularly where local people depend on natural ecosystems for their subsistence. We surveyed 784 people in villages in and around Chatthin Wildlife Sanctuary (CWS) to elicit information on forest product use, agriculture practices, and socioeconomics. CWS is the largest dry tropical forest protected area in Myanmar and the last viable stronghold for the endangered Eld's deer (*Cervus eldi*). Our studies demonstrate that people with fewer means and lower education levels are more dependent on the forest for essential resources. We found 67% of the households collect non-timber forest products and 33% hunt in the forest. Villagers collect fuelwood, fodder, over 90 medicinal plants, 50 food and household products, and thatch for houses from the forest. The average yearly household income is \$550. To assess effectiveness of CWS protection efforts we analyzed five satellite images covering 32 years (Landsat MSS: 1973; Landsat TM: 1989, 1992; Landsat ETM+: 2001; ASTER: 2005). Overall, habitat loss was significantly higher outside the sanctuary, resulting in nearly total deforestation and demonstrating the enormous pressures on the reserve. We conclude that despite habitat loss, CWS provided significant protection for Eld's deer in the past. However, without changes to government land use policies in surrounding areas, CWS and its associated Eld's deer population will continue to decline. We are currently developing conservation partnerships to regulate and manage forest use in a sustainable, equitable way, e.g. by piloting community forestry projects based in nearby villages and promoting use of fuel-efficient stoves.



## INVERTEBRATE CONSERVATION IN THE TROPICS

Axel Hochkirch<sup>1</sup>

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Halting the loss of biodiversity by 2020 is one of the Aichi biodiversity targets (target 12), on which the conference of the parties (COP 10) of the Convention on Biodiversity (CBD) has agreed upon in 2010. However, it is very unlikely that this target can be met given the strong ongoing global pressures on biodiversity. In order to evaluate the success of target 12, information on the population trends of endangered species is needed. The IUCN Red List is considered a useful tool to assess such biodiversity trends ('barometer of life'). However, one shortcoming of the IUCN Red List is its incompleteness and its strong bias towards vertebrate taxa. The underrepresentation of invertebrates and plants on the IUCN Red List is probably driven by the comparatively low number of experts for these groups (compared to the species numbers), which are the only potential assessors. Little is known on population trends of invertebrates (particularly in the tropics), and most red list assessments are based on the range sizes and habitat trends. A more strategic approach is needed to change the representation of invertebrates on the IUCN Red List. One possibility would be to recommend mandatory red list assessments with each taxonomic revision. However, there is also a strong need for a better organization of invertebrate conservationists. While the documentation of the conservation status on the Red List is a first step to identify priority species, conservation measures on the ground are also important. We recently started several field studies to obtain data on the distribution, habitat preferences and threats of tropical insects. A recent study on the ecology of endemic Orthoptera from the Seychelles provided useful information for the existing conservation project on the ground.

WEDNESDAY 14:45



## SUPPLEMENTARY FOOD ENHANCES NEST-BUILDING IN THE ENDANGERED CAPE VULTURE (GYPS COPROTHERES)

Dana G. Berens<sup>1</sup>, Sonja Heuner<sup>1</sup>, Michael V. Neethling<sup>1</sup>, Roger Uys<sup>2</sup>, Nina Farwig<sup>1</sup>

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WEDNESDAY 15:00

Vultures play an important role in the functioning of ecosystems as they limit the spread of diseases and contribute to the nutrient cycle by recycling carcasses. Yet, the number of vultures is declining worldwide due to numerous threats, such as poisoning and collisions with power-lines as well as the lack of adequate food sources. Vulture restaurants, i.e. supplementary feeding stations, have become a successful conservation tool to support vulture colonies. However, it is poorly understood how vulture restaurants influence population dynamics and whether they increase breeding success of vulture populations. Therefore, we used data from a breeding colony and a nearby vulture restaurant to investigate the effect of supplementary feeding on the breeding success and population dynamics of the endangered Cape Griffon (*Gyps coprotheres*). In order to consider the importance of food availability for parental and young birds during different breeding stages, we differentiated the breeding period into a nest-building, incubation and rearing stage. We found a significantly positive effect of supplementary food on the number of nests during the nest-building stage. However, breeding success did not depend on supplementary food during the incubation and rearing stage. This may be explained by an increased abundance of predators and food competitors at the restaurant at higher food quantities, which might diminish a positive effect of supplementary food. Our results demonstrate that carefully managed vulture restaurants can enhance the population dynamics of vulture colonies and can therefore be seen as a successful tool for vulture conservation.

## ENDORISING REDD+ IN THE INSTITUTIONAL MECHANISMS: HOW COULD TROPICAL FORESTS AND VOLUNTARY INITIATIVES BE AFFECTED?

Alessia Portaccio<sup>1</sup>, Davide Matteo Pettenella<sup>1</sup>, Lucio Brotto<sup>1</sup>

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Tropical deforestation emits a remarkable amount of carbon. The land sector offers many cost-efficient market-based offset mechanisms that the institutional framework has not developed or even envisaged. The Voluntary Carbon Market (VCM), the main source of carbon finance for forest conservation, shows its efficiency in involving the civil society, favouring small projects thanks to its low transaction costs, and allowing the trial of methodologies not yet approved in the regulatory front (like the Reducing Emissions from Deforestation and Degradation – REDD+ - strategy). VCM bases upon robust certification standards which verify that carbon credits are not double-counted and stress the co-benefits value (biodiversity safeguard, water quality, indigenous rights, etc.). REDD+ under the VCM demonstrated to be a successful result-based funding approach addressing multiple aims besides climate change. To support this statement the paper analyses the “Getting REDDy” project implemented in the Brazilian rainforest by an Italian local public administration (Trento Province). At the 19<sup>th</sup> UNFCCC Conference in Warsaw, REDD+ became a formal system with agreed rules on reference levels, mitigation activities, institutions creation, safeguards, and financing instruments. It is difficult to foresee which impact the REDD+ institutionalization could have on the VCM. The new compliance system could supplant the VCM, since it developed under the relatively weak or uncertain regulatory frame; but if the set targets reveal to be misleading, forest would have lost a valid defender. However, it is likely that VCM will not collapse, but even slightly grow, boosted by strengthen regulatory drivers. The stable but flexible VCM could maintain its innovative character, therefore seeding tomorrow’s markets. The VCM retention would guarantee the civil society empowerment in the environmental and climate concerns and it would offer peerless opportunities to save forests (mainly the tropical ones).

**Merian Award Applicant**

WEDNESDAY 15:15



## FROM COCA TO COCOA - ECONOMIC SUSTAINABILITY OF SMALLHOLDER COCOA PRODUCTION BY RECOVERY OF NATIVE COCOA VARIETIES IN PERÚ

Julia Susanne Kieck<sup>1</sup>, Roberto Gomez Aliaga<sup>2</sup>, Arne Cierjacks<sup>1,3</sup>, Reinhard Lieberei<sup>1</sup>

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<sup>3</sup>Technical University of Berlin, Department of Ecology, Ecosystem Science / Plant Ecology, Berlin, DE

WEDNESDAY 16:00

Many livelihoods in the Amazon basin of Perú economically rely on illegal coca cultivation. To provide a legal alternative for these smallholder farmers, cocoa which originates in this region was reintroduced as a commercial plant since the 1990s. In the first years of this campaign, the highly productive and pest-resistant bulk cocoa clone CCN-51 was promoted and cultivated in monoculture. This led to low and variable stock price dependency of the famers. Most recently, fine and flavour cocoas (Criollo, Trinitario and Nacional) are taken into consideration as these varieties obtain higher and more stable prices if processed adequately. Therefore, Trinitario clones were planted in the region, and - as the aroma is influenced by both genetic background and post-harvest treatments - farmers were trained in adapted cultivation, fermentation and drying techniques. Simultaneously, native cocoas with specific aroma profiles were revitalized. In this study, we explored the impact of fermentation treatments on quality criteria of seven Trinitario clones which were promoted for farmers' use in the state of San Martin, Perú (ICS-1, ICS-6, ICS-39, ICS-95, IMC-67, TSH-565 and UF 613). In addition, 40 native cocoa clones were collected and characterized. The analysed Trinitario clones proved to be an economically interesting alternative with high quality and yield (2 to 3.5 t per hectare in a well maintained plantation with a planting density of 1,111 individuals ha<sup>-1</sup>). Fermentation of a clone mixture led to best results when carried out for 6 days in insulated boxes. The results were summarized in a standard protocol which aims at optimizing product quality in terms of flavour and secondary metabolites. A couple of native clones showed characteristics of high-quality fine and flavour cocoa and may contribute to a more secure livelihood of smallholder farmers. Thus, local cocoa diversity provides a promising ecosystem service and should be protected and promoted.

## TOWARDS THE CONSERVATION OF THE NEOTROPICAL CYCAD GENUS *DIOON* (ZAMIACEAE, CYCADALES): IMPLICATIONS FROM PHYLOGEOGRAPHIC APPROACH

José Said Gutiérrez Ortega<sup>1</sup>, Tadashi Kajita<sup>1</sup>, Andrew Vovides<sup>2</sup>, Miguel Ángel Pérez Farrera<sup>3</sup>, Francisco Molina Freaner<sup>4</sup>

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<sup>3</sup>*Universidad de Ciencias y Artes de Chiapas, Tuxtla Gutiérrez, MX*

<sup>4</sup>*Instituto de Ecología, Universidad Nacional Autónoma de México, Hermosillo, MX*

The Neotropical cycad genus *Dioon* comprises fourteen endangered endemic species from Mexico and Central America. Most of *Dioon* species are geographically restricted and consist of small populations scattered mostly in tropical dry forests in the main mountain systems. Their discontinuous distributions have been attributed to short-distance dispersal and the historical demography through the climate changes since the Pleistocene. However, the phylogeography, particularly the history of speciation and intraspecific evolution, has not been studied on *Dioon*. Understanding the phylogeographic patterns of *Dioon* may help to identify evolutionary units which may be considered for further conservation. The aim of this study concerns on that issue. The first phylogeographic study on *Dioon* is presented here, focusing on the northernmost species, *D. sonorensis*. Leaflets of 77 individuals were collected from an extensive sampling in almost all the extant populations of *D. sonorensis*. DNA sequences of several regions of the chloroplast genome were examined. Only three haplotypes were identified in the entire distribution range, and the genetic variation was found to be low. However, the three haplotypes were geographically structured, which may suggest that they belong to different evolutionary units. Since the northern and middle populations are not preserved, but represent unique haplotypes, their inclusion in conservation plans is strongly recommended. The phylogeographic approach is promising for revealing the evolutionary history of *Dioon* and for identifying conservation units. Therefore, the study was expanded including all the other *Dioon* species. Some haplotypes showed wide geographical distributions and were shared by several different species. One haplotype is found on *D. sonorensis* and its sister species *D. tomasellii*. These findings suggest that the shared haplotypes among species might be the result of ancestral polymorphism, or genetic introgression between species.

**Merian Award Applicant**

WEDNESDAY 16:15



## SESSION 6:

### LANDSCAPE ECOLOGY IN THE NEOTROPICS: LAND USE CHANGE TRENDS AND SUSTAINABLE MANAGEMENT

[ Short title: Landscape ecology in the Neotropics]

Chair: Karl M. Wantzen

Contact: karl.wantzen@univ-tours.fr

Increasing demand on food and fiber in the US, Europe and in the fast developing Asian regions increase pressures on land use change in rural landscapes, specifically in the Neotropics. In this session, we want to analyze the drivers for land use change, compare the socioeconomical and legislative setting and their effects on ecological integrity and biodiversity patterns in different Latin American countries, and offer scientific baselines for evidence-based policies for a sustainable landscape management in the Tropics in general. Keywords for presentations: Fragmentation analysis, bioindicator species, soil ecology, agro-ecology, microcatchment, carbon and nutrient cycling, conservation and reconciliation strategies.

THURSDAY 09:15

## CERRADO: FRAGMENTATION AND OPTIONS FOR RESTORATION

Karl M. Wantzen<sup>1</sup>, Auberto Siqueira<sup>2</sup>

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The State of Mato Grosso, Brazil has undergone intensive land use changes in the past decades. Native ecosystems of Cerrado, Amazonia and Pantanal have been converted to agriculture for the production of cash crops and cattle. The Brazilian Forest Code advocates full protection of specifically sensitive habitats and it also safeguards a fixed percentage of native vegetation known as “Legal Reserves” (LRs) inside private rural properties. These percentages account for 35% of savannas and 80% of forests found inside each rural property for the State of Mato Grosso. Here we analyze, at biome scale, the change in the state of the native vegetation cover (NVC) from 1992 to 2007 and the representativeness of NVC types within the LRs, as well as the role of LRs for general landscape configuration and conservation. In Mato Grosso, 90% of all studied types of NVC are represented inside LR patches. Legal reserves also accounted for 37% of the total protected areas and for 30.7% of all remnants of NVC found in Mato Grosso in 2007. The importance of LRs on landscape structure varied greatly according to each biome, but it is noteworthy that LRs were generally missing in highly deforested zones. The relative small size of LRs in all biomes (55% up to 64% of them are  $\leq 12$  ha) makes them specifically vulnerable to further changes in land use. Contrary to the current tendency towards further fragmentation, the importance of LRs for landscape connectivity should be increased, by improving the network of corridors between the remnants of vegetation.

THURSDAY 09:15



## DEGRADATION OF BIODIVERSITY AND ECOSYSTEM FUNCTIONING IN SUBTROPICAL GRASSLANDS, AND THRESHOLDS FOR RESTORATION

Johannes Kollmann<sup>1</sup>, Julia-Maria Hermann<sup>1</sup>, Martin M. Goßner<sup>2</sup>, Christiane Koch<sup>1</sup>, Sebastian T. Meyer<sup>2</sup>, Gerhard E. Overbeck<sup>3</sup>, Wolfgang W. Weisser<sup>2</sup>

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Ecological restoration aims at maximizing biodiversity and restoring ecosystem functions. Current theory assumes that human-impacted ecosystems show distinct degradation stages that are characterized by deviation in abiotic and biotic conditions from reference ecosystems, deterioration of ecosystem functions, and resilience thresholds that define if degraded ecosystems can return to a particular stage. While this theory provides a useful conceptual framework, it has rarely been tested. In an ongoing project we apply, test and further develop this framework for the case of South American grasslands. South American grasslands are rich in biodiversity and they are under pressure due to changing land use. In Rio Grande do Sul, Brazil, about 50% of the grasslands have been converted to agriculture, forestry or lost due to urban expansion. Only about 2% are within nature reserves where, on cessation of human action natural succession with woody species takes place. The grasslands exist in various degradation and restoration stages that might differ in their ability to support specific ecosystem functions, but the relative stability of these stages and potential transition thresholds are largely unknown. This is particularly true for hybrid and novel ecosystems which feature species combinations that have not occurred previously within the study region and result of unsustainable land use and biological invasions. First results will be presented of large-scale surveys of degraded grasslands and rapid assessments of ecosystem functions in the highlands of Rio Grande do Sul. The project also investigates management practices that shift grasslands across resilience thresholds beyond which they are unable to return to the reference state without human assistance. The applied outcome of the project are recommendations for grassland restoration and for management of hybrid and novel ecosystems.

THURSDAY 09:30



## LAND USE CHANGE IN SOUTHERN PARÁ, CENTRAL BRAZIL: A DIFFERENT RESPONSE OF TOPSOIL AND SUBSOIL HORIZONS

Simone Strey<sup>2,3,4</sup>

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Soil organic carbon (SOC) stocks are a result of accumulation and decomposition of organic matter, and are often considered to be in steady-state equilibrium under native vegetation. Land use change generally results in a disturbance of this balance, leading to modifications of SOC storage and distribution within the profile. Southern Amazonia became one of the greatest agriculture frontiers in the world within the last 30 years, affected by a transition from native forest to pasture to cropland. Facing this development the objectives of our study were to analyze the impact of land use change on vertical SOC distribution and the latency of subsoil OC in contrast to topsoil OC.

To approach this, we analyzed SOC up to 1m under native vegetation (n=7) and pasture (n=7) in southern Pará. At each plot (100m x 100m) we collected soil samples from depths of 0-10, 10-30, 30-60, 60-100cm with an Edelman-Augur in 9 replicates, and in total 648 samples were measured for SOC and  $\delta^{13}\text{C}$ . Bulk densities were calculated from core samples, taken every 10cm in triplicates.

First results indicate a decline of SOC concentrations in topsoil horizons (0-10 cm) within 10 years after clearing native vegetation ( $21.5 \pm 1.44 \text{ g C kg}^{-1}$ ; n=62) for pastures ( $17.6 \pm 1.57 \text{ g C kg}^{-1}$ ; n=15). However, equal SOC concentration of old pastures ( $21.4 \pm 0.92 \text{ g C kg}^{-1}$ ; n=46) and primary forests indicate that a new equilibrium in topsoil is achieved two decades after forest clearing. Our  $\delta^{13}\text{C}$  measurements show that in topsoil horizons of young pastures (<10a) about 68% ( $14 \text{ Mg C ha}^{-1}$ ) of SOC still derived from forest, whereas in older pastures (>20a) only 42% ( $10 \text{ Mg C ha}^{-1}$ ) of SOC consist from original native vegetation.

Subsoil horizons (60-100 cm) seem to have a much slower response on land use change effects. According to this, we could not detect any significant differences in  $\delta^{13}\text{C}$  ratios in greater soil depth when comparing primary forests ( $-25.74 \pm 0.14 \text{ ‰}$ ; n = 62) to young ( $-25.91 \pm 0.09 \text{ ‰}$ ; n = 15) and old pastures ( $-25.67 \pm 0.11 \text{ ‰}$ ; n = 46). Therefore, we assume that even more than 25 years after deforestation, SOC in subsoil horizons still almost only originate from native vegetation. Hence, the input to deeper soil horizons by pasture appears to be very limited, in contrast to the native vegetation, which needs to be considered in the evaluation of consequences of land-use change on SOC stocks.

THURSDAY 09:45



## DEEP SOIL ORGANIC CARBON: A CALL FOR GREATER CONSIDERATION

Robert Strey<sup>2,3,5</sup>

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Soils are the greatest reservoirs of organic carbon on Earth, but many studies only consider the first meter when soil organic carbon (SOC) stocks are calculated. This may lead to a significant underestimation of SOC stocks, especially in deeply weathered soils of tropical ecosystems. Therefore, more validated data about deep SOC stocks are crucial not only for a better understanding of possible negative effects accompanied with land use change in greater soil depth, but also for more profound estimations of financial values of primary forests concerning REDD policies and projects. Concerning the fact of missing data about deep SOC the objective of this study was to generate a valid data stock about the distribution and stocks of SOC deeper than 1m.

Addressing this, we analyzed SOC up to 10 m in a soil pit situated in an undisturbed native rainforest in southern Pará, Brazil. We collected soil bulk samples every 20 cm with fourfold repetition. Furthermore, we took three core samples every meter to calculate bulk density.

While the Brazilian governmental organizations IPAM and ISA estimated OC stocks in vegetation and soil for this area of 90-141 Mg C ha<sup>-1</sup>, we found 209 Mg OC ha<sup>-1</sup> in the soil only. Our results show that only 14% (29 Mg C ha<sup>-1</sup>) is stored in topsoil (0-20cm), while the first meter contains 50% (104 Mg C ha<sup>-1</sup>) of total SOC stocks. Despite an exponential decrease of the SOC concentration with depth, meter two and three still hold 24% (50 Mg OC ha<sup>-1</sup>) resp. 10% (21 Mg OC ha<sup>-1</sup>), which underlines the importance of deep SOC in highly weathered soils.

Furthermore, all four sampling lines show a very high accuracy ( $r^2 \geq 0.98$ ) for an exponential decay fit ( $y_0 + A \cdot \exp(-x/t)$ ), where  $y_0 = 0.024 (\pm 0.005)$ ,  $A$  = Amplitude (SOC concentration at 1 cm),  $x$  = soil depth and  $t = 101.58 (\pm 3.83)$ . Though the parameters  $y_0$  (0.024) and  $t$  (101.58) need further validation, they might be used for calculations of vertical SOC distribution in studies of deeply weathered Ferralsols where sampling at greater depth is not possible.

THURSDAY 10:00

## CAN OIL PALM EXPAND WITHOUT DAMAGING BIODIVERSITY IN COLOMBIA?

Graham Prescott<sup>1</sup>, James Gilroy<sup>2</sup>, Johann Cardenas<sup>4</sup>, Pamela González del Pliego Castañeda<sup>3</sup>, Andrés Sánchez<sup>4</sup>, Brigitte Baptiste<sup>4</sup>, Claudia Medina<sup>4</sup>, Torbjørn Haugaasen<sup>2</sup>, William Foster<sup>1</sup>, David Edwards<sup>3</sup>

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<sup>3</sup>*University of Sheffield, Sheffield, UK*

<sup>4</sup>*Instituto de Investigación de Recursos Biológicos Alexander von Humboldt, Villa de Leyva, CO*

Colombia is a megadiverse country and the biggest producer of palm oil in the Neotropics. The Colombian government and oil palm growers association plan to increase palm oil production sixfold by 2020. We aimed to compare the biodiversity of several taxa in oil palm plantations, forest fragments and intensive cattle ranches in the llanos region of Colombia, to assess impacts of oil palm expansion on biodiversity. We sampled birds, ants, dung beetles, frogs, snakes and lizards in each habitat type using point counts (for birds) and pitfall traps (for other taxa). We found that of the three habitat types, forest fragments had the highest species richness, followed by oil palm plantations, with cattle ranches having the least; this pattern held across all taxa investigated. This suggests that oil palm expansion at the expense of forest could lead to biodiversity loss, but that expansion at the expense of cattle ranches (which are also less economically productive) would not. This suggests that expansion of oil palm plantations, if managed well, need not imperil biodiversity in Colombia.

**Merian Award Applicant**

THURSDAY 10:15



## HERBACEOUS FERNS AND ANGIOSPERMS AS INDICATORS OF SOIL PARAMETERS ALONG AN ALTITUDINAL GRADIENT AT THE “COFRE DE PEROTE” (VERACRUZ, MEXICO)

Jorge Antonio Gomez Diaz<sup>1</sup>, Felix Heitkamp<sup>1</sup>, Gerhard Gerold<sup>1</sup>

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<sup>2</sup>Universidad Veracruzana, Xalapa, MX

Bioindicators like herbaceous ferns and angiosperms provide information about environmental factors because they are sensitive to changes in the environment. This information is rare in tropical and subtropical environments. Based on spatial distribution patterns we will test, if one or both of the previously groups could be used as indicators for soil parameters (available nutrients, acidity, humus content). This study will look into floristic patterns of these groups and soil parameters in an altitudinal gradient (0-3500 m) at Cofre de Perote's Mountain. The fieldwork was done in five altitudinal belts and vegetation types. Sampling points were located every 500 m of altitude at primary forests and human disturbed habitats (disturbed forest and secondary vegetation). In each sampling plot (20 x 20 m) we collected samples of herbaceous ferns, angiosperms and soil samples. Almost 91 morph species were recorded of which 68% have been identified to family level and the rest to species level. From the total of species 60% belong to the angiosperm group and the rest to the pteridophytes group. The frequency of species was calculated and it was determined that 79% of the species are rare, 14% scarce, 3% regular and 3% generalists. This pattern is interesting because probably most of these species are adapted to microhabitats and they could work as indicators. In the belts of 1500 and 2500 m there is no significant difference in soil pH and C/N ratio between the several vegetation types. The soil of the secondary forest at the belt of 3000 m is more acidic ( $p=0,007$ ) than in the other vegetation types. Eventually, we hope to provide a list of indicator species for each habitat, useful for monitoring and restoration programs. Achieved basic knowledge on the requirements of the studied species will help to orientate how to protect them too.

THURSDAY 10:30



## SESSION 7:

### FREE SESSION

[ Short title: Free session]

Chair: Johannes Kollmann

Contact: [jkollmann@wzw.tum.de](mailto:jkollmann@wzw.tum.de)

THURSDAY 09:15

## HELPING BEHAVIOUR ON INJURED NESTMATES IN THE TERMITE HUNTING ANT SPECIES *PACHYCONDYLA ANALIS*

Erik Frank<sup>1</sup>, K. Eduard Linsenmair<sup>1</sup>

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The termite hunting ant species *Pachycondyla analis* is well known for its organised column like formation moving to and from termite feeding sites. During raids, which normally take place 3-5 times a day, the majors break open the protective soil layer over the termite-feeding sites so that the minors can enter to kill and carry out the prey. While observing raids in Comoé National park (Northern Ivory Coast) on the predominantly hunted termite species *Pseudocanthotermes* sp. we noticed that about 4 ants per raid got carried back to the nest, either being directly picked up at the termite feeding site or on the way back. Prior studies observed similar behaviour and assumed, without verification, that dead ants were carried back to the nest. However, we observed that these ants were invariably alive but obviously injured. When closely approached or contacted by a nestmate they assumed a pupa-like position. The injury risk during raiding manoeuvres can be very high. The most common injury observed is caused by termites that have bitten themselves onto an ant's limb. Experiments in which we artificially injured marked ants proved that only live ants got transported back to the nest and that they again took part in later raids of the colony, while dead ants were only investigated shortly and then ignored. Further assessments indicate that about 24 % of all minors in an ant colony showed some kind of injury (missing limb or antenna) while only 4 % of the majors were injured. Termite heads that still stuck on the body of injured ants were removed safely inside of the nest without removing the bitten limb. So we have to conclude that this is indeed helping behaviour and first observations seem to suggest that this helping behaviour is pheromone driven. This study is the first one in which helping behaviour has been observed in social insects.

**Merian Award Applicant**

THURSDAY 09:15



## HABITAT USE AND ECOMORPHOLOGY IN CENTRAL AMERICAN WANDERING SPIDERS

Witold Lapinski<sup>1</sup>, Marco Tschapka<sup>1</sup>

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Sympatric occurrence of species is thought to be mainly based on the differences in their habitat use and the use of limiting resources. Segregating parameters may be of spatial or temporal character and may include behavioral differences. We hypothesized that large hunting spider species living sympatrically in a Costa Rican lowland rain forest should differ in their habitat and / or hunting microhabitat preferences, and, as an adaptation to the preferred hunting microhabitat, in their specific ability to adhere to smooth surfaces. We found an assemblage of eight large species of the families Ctenidae and Trechaleidae, consisting of three subguilds: (1) two semi-aquatic species with low adhesion ability, (2) three forest ground dwelling species with good adhesion ability, and (3) three vegetation dwelling species, showing very good adhesion ability. The species were partially segregated by habitat type, with two of the vegetation dwelling species preferring the treeless area of a temporary swamp. Differences in the sets of adhesive hairs on the tarsi of the legs reflected the microhabitat preferences of the spider species. The similarity in community structure between this Costa Rican and a central Amazonian assemblage suggests the existence of similar structuring mechanisms in wandering spider assemblages in climatically similar biomes.

**Merian Award Applicant**

THURSDAY 09:30



## UNDERSTANDING MULTI-TROPHIC INTERACTIONS FOR APHID BIOCONTROL ON THE TROPICAL VEGETABLE CROP OKRA: AGRICULTURAL IMPLICATIONS IN CAMEROON

Akanksha Singh<sup>1,2</sup>, Sharon Zytynska<sup>1</sup>, Rachid Hanna<sup>2</sup>, Wolfgang Weisser<sup>1</sup>

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Tropical systems harbor great species diversity and for pest biocontrol it is crucial to understand how species interact on a multi-trophic level. In Cameroon, West Africa, Okra (*Abelmoschus esculentus*) is a commonly cultivated vegetable and the melon-cotton aphid (*Aphis gossypii*) is one of the major insect pests. The natural enemies of aphids on Okra include parasitoid wasps, syrphid fly larvae and spiders; however, the parasitism rate of aphids here is low, possibly due to frequent pesticide spraying. Furthermore, mutualistic associations between aphids and ants can protect aphids from their natural enemies, and hinder biological control efficiency.

In a field study and a controlled greenhouse study we investigated the role ants play in the interactions between okra and aphids. We found that ants did not benefit aphids on Okra and their effect on aphids differed on different Okra varieties. Our study highlights the role of many factors that shape ant-aphid-plant interactions.

THURSDAY 09:45



## CORONAVIRUS DISEASE ECOLOGY IN WEST AFRICAN BATS

Heather Baldwin<sup>1,2</sup>, Victor Corman<sup>3</sup>, Stefan Klose<sup>1</sup>, Evans Nkrumah<sup>4</sup>, Ebenezer Badu<sup>4</sup>, Priscilla Anti<sup>4</sup>, Augustina Annan<sup>4</sup>, Michael Owusu<sup>4</sup>, Olivia Agbenyega<sup>4</sup>, Samuel Oppong<sup>4</sup>, Yaw Adu-Sarkodie<sup>4</sup>, Peter Vallo<sup>1,5</sup>, Elisabeth Kalko<sup>1,6</sup>, Jan Felix Drexler<sup>3</sup>, Christian Drosten<sup>3</sup>, Marco Tschapka<sup>1,6</sup>

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Bats are important reservoir hosts to a number of emerging viruses, including SARS-coronavirus (CoV), Hendra and Nipah viruses, as well as Ebola and Marburg viruses. These pathogens can cause problems for public health, animal industries, and wildlife conservation. To minimize the risk of future epidemics, knowledge about the reservoir hosts is required. We need to understand how ecological factors may influence disease dynamics and drive host-switching and emergence. While numerous studies have aimed at discovery of novel infectious diseases in bat populations, little research has examined the role of host ecology on pathogen dynamics and diversity. We investigated the influence of host phenology and demography on the dynamics and diversity of CoVs in West African cave-dwelling bats.

We screened over 7,000 bat faecal samples from 15 species, collected regularly over two years at ten bat colonies in Ghana, for CoVs. Four CoV lineages were quantitatively detected using highly sensitive strain-specific real time RT-PCR assays. Here, we report on results on host demographic, phenological and seasonal influences on infection dynamics. Preliminary findings suggest that CoVs were preferentially carried by juvenile bats and lactating females, corresponding to seasonal spikes in virus amplification once per year linked to bat reproductive cycles. These data may imply the potential of host colonies as settings conducive to host-switching events. In sub-Saharan Africa, where bat-human contact is relatively high, these kinds of ecological insights into the study of emerging diseases are crucial to making informed management decisions about both mitigation of potential threats to human public health and wildlife conservation.

**Merian Award Applicant**

THURSDAY 10:00

## CANOPY GAPS, UNDERSTORY LIGHT ENVIRONMENTS AND SEEDLING DISTRIBUTION IN A SUBTROPICAL RAINFOREST EXPERIENCING ANNUAL TYPHOON DISTURBANCE

Ai-Wen Yao<sup>1</sup>, Jyh-Min Chiang<sup>2</sup>, Ryan McEwan<sup>3</sup>, Teng-Chiu Lin<sup>1</sup>

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<sup>3</sup>*Dayton University, Dayton Ohio, US*

We examined gap characteristics, light availability and variability, and seedling diversity in both gaps and non-gaps in a subtropical forest with annual typhoon disturbance in Taiwan. We also compared the result to a gap survey at the same site conducted in 1995 following 6 typhoon disturbance in 1994. Gaps were smaller and covered much smaller proportion of the forest in our 2012 survey (mean gap size 10 m<sup>2</sup>, 3.3% of the forest) than in the 1995 survey (33 m<sup>2</sup> and 10%). Canopy regeneration times, 197 to 398 yr, estimated from the 2012 survey were considerably longer than the 51-175 yr estimated based on the 1995 survey. Neither light availability nor variability differed between gaps and non-gaps so that gaps provide no unique niches in terms of light environments possibly due to frequent canopy defoliation associated with annual typhoon disturbances. The lack of unique niches in gaps is likely the key to the lack of difference in species richness of seedlings, high community similarity (> 90%) between gaps and non-gaps, and the lack of seedling species occurring exclusively in gaps. Our study illustrates that in ecosystems with small canopy gaps resulting from frequent disturbance, gaps provide no unique understory light environments (niches) and therefore play a neutral role on maintaining plant diversity.

THURSDAY 10:15



## SESSION 8:

### BETWEEN PRODUCTION AND PROTECTION - TOWARDS A SUSTAINABLE MANAGEMENT IN THE TROPICAL ANDES

[ Short title: Sustainable management in the tropical Andes]

Chairs: Prof. Dr. Jörg Bendix, Prof. Dr. Dr. h.c. Erwin Beck

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Climate and Land Use Changes have proven as major threats to biodiversity and ecosystem services in biodiversity hotspots like the tropical Andes of South America. The economy of the tropical Andes is mainly based on agriculture which requires conversion of the natural mountain forest, harbouring the vast diversity and delivering important ecosystem services, to arable land. Conservation measures may help to protect ecosystems from degradation but they will be only accepted by the local population if livelihood can be improved at the same time. Thus, a sustainable management system of the Andean hotspot should rely on a balance between sustainable production and protection, with compensation measures as incentives. However, most of the recent production systems are not sustainable. At the same time, it is far from being well understood how a sustainable management system should be shaped in this complex ecosystems to maintain the diversity and services of the natural ecosystem components, but also the livelihood of the local population. Thus, the goal of the session is: (1) to quantify past environmental changes and the corresponding threats to biodiversity and ecosystem functioning and services, (2) to analyze changes of diversity and ecosystem services (qualitative, quantitative) using disturbance gradients, or ecological experiments (3) to propose and assess potential production and protection components of sustainable management systems, (4) to quantify ecologic, economic and social components of a sustainable management system, (5) to conduct numerical simulations and to evaluate future scenarios of different land management options, in/for the tropical Andean hotspot area.

THURSDAY 11:15

## LAND USE CHANGE IN THE TROPICAL ANDES OF SE-ECUADOR AND ITS EFFECTS ACROSS SCALES

Jörg Bendix<sup>1</sup>, Giulia Curatola Fernández<sup>1</sup>, Sandro Makowski Giannoni<sup>1</sup>, Rütger Rollenbeck<sup>1</sup>

<sup>1</sup>University of Marburg, Marburg, DE, [bendix@staff.uni-marburg.de](mailto:bendix@staff.uni-marburg.de)

It is globally undisputed that land use change (LUC) is one of the most important threats to biodiversity and a trigger of ecosystem degradation. This also holds for the Andes of south-eastern Ecuador, a global biodiversity hotspot where the vast species richness is mainly harboured by the natural mountain rain forest. In the San Francisco Valley, the study site of an interdisciplinary research project, forest is cleared by slash-and-burn to gain pasture land. Change detection based on remotely sensed data allows to quantify and interpret these LUC activities for the last decades. However, it is not clear which mechanisms are fostering land use change on the local scale. Several potential drivers are analyzed and will be discussed during the talk. At the same time, LUC is also occurring on a global basis. It could be shown that remote LUC activities as e.g. biomass burning in the Amazon lead to atmospheric deposition of macro-nutrients into the nutrient limited mountain forest, which might induce changes in ecosystem function and biodiversity. However, it is not yet finally clarified how much (and which) natural and anthropogenic sources contribute to the deposition. This question will be discussed in the talk by analyzing atmospheric NO<sub>x</sub> and SO<sub>2</sub> depositions in the mountain forest

THURSDAY 11:15



## LONG-TERM VEGETATION RESPONSES TO ENVIRONMENTAL CHANGES ACROSS THE SOUTH ECUADORIAN ANDES - A MULTI-SITE COMPARISON

Nele Jantz<sup>1</sup>, Corinna Brunschön<sup>1</sup>, Holger Niemann<sup>1</sup>, Fernando Rodríguez<sup>1</sup>, Andrea Villota<sup>1</sup>, Hermann Behling<sup>1</sup>

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The south Ecuadorian Andes are world-renown for their high species richness. However, here, natural ecosystems are threatened by high deforestation rates. Other environmental problems include overgrazing, fires and unsustainable cultivation systems. For the development of conservation strategies, knowledge about the natural state of an ecosystem with its dynamics and responses to a changing climate and other natural as well as human disturbances is indispensable. In this study, we present new insights into past landscape dynamics of the south Ecuadorian Andes based on palaeoecological data obtained by pollen and charcoal analyses. Multivariate analyses and a multiple site approach shed light on different aspects of landscape dynamics during the past millennia, such as the rate of change in pollen taxa composition and abundance, pollen richness patterns and changing intensity of fires. Results show parallel as well as diverging developments for the different sites. Whereas high impact events, such as the end of the last glaciation and the increase in fire intensity during the past ca. 4000 years, lead to noticeable changes of vegetation dynamics at most sites, other events seem to be more locally or regionally induced. A complexity of mechanisms and varying environmental conditions, differences in human disturbance regimes and vegetation patterns as well as high biodiversity are responsible for differing vegetation developments at sites throughout the Holocene. This indicates that vegetation response to less severe events in the Andes depends strongly on the local terrain and its environmental conditions but that with increasing severity, responses are more uniform across different sites.

**Merian Award Applicant**

THURSDAY 11:30

## RESPONSES OF A DRY AND HUMID TROPICAL FOREST TO CLIMATE VARIATIONS IN SOUTHERN ECUADOR: EVIDENCE FROM TREE-RINGS WIDTH AND STABLE ISOTOPE ANALYSES

Darwin Pucha Cofrep<sup>1,2</sup>, Achim Bräuning<sup>1</sup>, Thorsten Peters<sup>1</sup>, Eduardo Cueva<sup>3</sup>

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The tropical forest ecosystems in Southern Ecuador are biodiversity hotspots influenced by a complex climate system. At the same time, these ecosystems suffer from high anthropogenic pressure, and still little is known about their response to natural climate variability and human-induced environmental changes. However, such knowledge is crucial to develop conservation strategies for successful maintenance of biodiversity and ecosystem services them in future.

This study was conducted in two different ecosystems, in a dry forest in the “Reserva Natural Laipuna” at the western declivity of the Andes, and in the humid mountain rainforest “Reserva Biológica San Francisco” at the eastern Andean slope towards the Amazon region. Dendrochronological measurements and annually resolved stable isotope analysis of carbon and oxygen isotope variations ( $\delta^{18}\text{O}$  and  $\delta^{13}\text{C}$ ) in wood cellulose were carried out in selected tree species.

During the last decades, strong correlations were found between tree-ring widths and stable isotope variations with local and regional climate time series. In the dry forest, carbon isotopes were significantly correlated with the sea surface precipitation on the equatorial Pacific (Niño 3 and 4 regions), which is demonstrated by spatial correlation maps created with the KNMI climate explorer. These results point to the origin of local precipitation in the dry tropical forests from the Pacific Ocean and that precipitation is the main growth-limiting climate factor limiting tree growth in this ecosystem. In contrast, correlations of ring widths in the humid forest is highest with solar radiation input over the Andean uplands, where the major moisture input is brought from the Atlantic Ocean. The age of the studied tree species reaches up to more than 200 years. Thus, our results underline the suitability of tropical tree species from different tropical forest ecosystems in southern Ecuador to reconstruct large-scale climate patterns in the tropics.

**Merian Award Applicant**

THURSDAY 11:45



## IMPACT OF CLIMATE AND CLIMATE CHANGE ON THE DISTRIBUTION OF VASCULAR PLANTS IN SOUTHERN ECUADOR

Thorsten Peters<sup>1</sup>

<sup>1</sup>*Institute of Geography, Erlangen, DE, thorsten.peters@fau.de*

Since the announcement of the Millennium Ecosystem Assessment Report 2005 it is undeniable that land-use and climate change are threatening biodiversity. Based on the IPCC A<sub>2</sub> and B<sub>2</sub> scenarios, grid cell maps show that several parts of the tropical Andes might sustain dramatic temperature and precipitation changes. Already today some of these changes are visible in Southern Ecuador. Both areas, the western inter-Andean basin of Loja and the eastern Andean escarpment at Zamora reveal a significant warming trend. The ecological importance of such thermal trends is obvious. By assuming a warming trend until 2100, the increase of temperature must result in an altitudinal shift of ecothermal belts in the area. With regard to the upslope migration of thermophilous species, different authors state that suitable habitat corridors to higher areas are a precondition for uplift. In the Ecuadorian Andes the numerous valleys from the Precordillerean and Amazon forelands could represent such corridors. Changes in rainfall situation are more complex. Loja shows a very weak but significant trend towards an increase in rainfall. Until 1993, the contrary holds true for the eastern Andean foothills at Zamora. It seems that the rainfall trend changes along the W-E gradient: Areas west of the main Cordillera are affected by a slight increase of rainfall and vice versa. Concerning species diversity in tropical rainforests, a couple of papers affirm that most of these ecosystems will apparently suffer from species losses due to climate change and several climate conditions, which favoured the Ecuadorian biodiversity hotspot during the 20<sup>th</sup> century, may disappear entirely during the 21<sup>th</sup> century. Many Andean taxa are restricted to narrow ranges of temperature and humidity, resulting in high rates of endemism and species turnover across altitude and space. It is therefore anticipated that climate change will require compensatory species range shifts of unprecedented pace.

THURSDAY 12:00



## CLIMATE CHANGE ADAPTATION IN THE TROPICAL ANDES - UNDERSTANDING AND MODELLING LOCAL SMALLHOLDER REALITIES

Andre Lindner<sup>1</sup>, Jürgen Pretzsch<sup>1</sup>, Uta Berger<sup>2</sup>

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The alarming increase in extreme weather events are major consequences of climate change in tropical mountain ranges like the Andes of Bolivia and Peru. The impact on farming households is of growing interest since adaptation and mitigation strategies are required to keep pace with environmental conditions and to prevent people from increasing poverty. In this regard it becomes more and more obvious that a bottom-up approach incorporating the local socio-economic processes and their interplay is needed. Socio-economic field laboratories are used to understand such processes on site. Farmers react individually based on (i) their experiences, (ii) financial situation, (iii) labor conditions in the family, (iv) education, or (v) attitude among others. In this regard socio-economic field laboratories also serve to develop and test scenarios about development paths, which involve the combination of both, local and scientific knowledge. To make the outcome transferable to other sites an agent-based modelling (ABM) approach is applied, which permits to capture the individuality of humans' behavior as well as the multitude of interactions among them. Assuming the model development is based on a comprehensive observation of the particular system, ABMs in combination with continued ground proofing can be used to gain insights into its functioning and to forecast its development in the near future. Hence the results are capable to provide valuable information, which can work as a communication tool to bridge the gap between adaptation policies and local realities.

**Merian Award Applicant**

THURSDAY 12:15



## BAD WEEDS GROW TALL: A COMPILATION OF TEN YEARS RESEARCH ON THE BRACKEN (PTERIDIUM SPP.) PROBLEM IN THE TROPICAL ANDES OF SOUTH ECUADOR

Erwin Beck<sup>1</sup>, Kristin Roos<sup>1</sup>, Jörg Bendix<sup>2</sup>, Brenner Silva<sup>2</sup>, Guglia Curatola<sup>2</sup>, Ingo Voss<sup>3</sup>, Nico König<sup>3</sup>, Renate Scheibe<sup>3</sup>, Karin Potthast<sup>4</sup>, Ute Hamer<sup>5</sup>, Julia Gawlik<sup>6</sup>

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<sup>6</sup>*Inst. of Geography, Friedrich Alexander University of Erlangen, Erlangen, DE*

A synopsis will be presented on the competition between bracken and the common pasture grass *Setaria sphacelata* on areas where the native tropical mountain forest has been cleared by slash and burn.

The following aspects shall be discussed:

Taxonomy of the complex "Southern Bracken" and genetic diversity of the populations in the research area.

The value of *Setaria* as pasture grass.

Competitive response of two different herbaceous plant functional types to the climate conditions, soil properties and recurrent burning.

Vegetation dynamics after clearing of the forest and the spreading of bracken.

Regeneration of the pastures and a protocol for sustainable pasture farming.

## LOCAL ADAPTATION AND ANTHROPOGENIC IMPACTS ON *CEDRELA ODORATA* L. ACROSS THE TROPICAL ANDES: SEED SOURCES FOR REFORESTATION IN ECUADOR

Claudia Armijos-Ojeda<sup>1,2</sup>, Juan Iglesias<sup>2</sup>, Renato Valencia<sup>2</sup>, Sven Günter<sup>1</sup>, Bernd Stimm<sup>1</sup>

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The major challenge to increase the area of forest plantations with native species in Ecuador is to obtain the suitable reproductive material in terms of genetic diversity structured by geographic differences and desirable traits for tree improvement. Local adaptation of available *Cedrela odorata* populations with potential as seed sources has been tested. Four provenances with contrasting habitat types were selected: two in the Pacific coastal region to the West of the Andes, and two in the Amazonian basin region to the East of the Andes. We assessed survival and growth within a reciprocal transplant experiment. The germplasm was reciprocally grown in four tree nurseries and sown all in the four nearby areas.

We recorded differential viability in the nurseries and survival abilities after transplant. After three months in the nursery and half a year of reciprocal transplant, the establishment performance of the seedlings and saplings varied between the provenances but mainly between plantation sites. These results suggest highly environmental sensitivity for the species in Ecuador and hence provenance - site matching for designing future forest plantations is strongly recommended.

The studied provenances perform better in the sites of origin only under limited circumstances. In both sites in the Pacific coast, the local provenances grew taller. In the Amazonian region, the best example of local adaptation has been recorded for the Yasuní provenance due to the high germination, survival and growth under extreme low soil pH and high levels of aluminum toxicity. In such conditions, the non-autochthonous provenances could not outperform the autochthonous reproductive material.

Overall, the best performance was registered for two provenances located in and nearby state protected areas with continuous forest cover. Thus degree of human intervention on the sampled populations and presumably on the pollinators has been discussed as a parallel factor to the establishment performance of the tested provenances.

This study offers insights into the potential of seed transfer across the tropical Andes and aims at providing with guidelines and awareness of ecological criterion for seed sourcing *C. odorata* in northern Ecuador.

**Merian Award Applicant**

THURSDAY 15:00



## FOREST SITE CLASSIFICATION AS BASIS FOR SUSTAINABLE SILVICULTURE IN SOUTHERN ECUADOR

Pablo Quichimbo<sup>1,2</sup>, Leticia Jiménez<sup>2</sup>, Alexander Tisher<sup>1</sup>, Ute Hamer<sup>3</sup>

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In the tropical Andes of southern Ecuador afforestation and conversion of monocultures into mixed forests are management strategies bridging the gap between production and protection. For example pine monocultures, established on large scale in Ecuador since the beginning of the previous century, are known to have negative environmental effects and are financially non profitable. Thus, the conversion of pine plantations into mixed forests with native tree species is of utmost importance.

One prerequisite for the implementation of sustainable silviculture in Ecuador is a forest ecosystem management, which is adapted to the respective site conditions, i.e. climate, location and soil. So far, for Ecuador no forest site classification exists.

Therefore, in the province of Loja soil properties were analysed in pine (*Pinus patula*) plantations located in different climatic zones. In total 23 soil profiles were classified.

Physico-chemical soil properties important for plant growth like soil organic carbon (SOC), total nitrogen (TN), total elements (e.g. K, Mg, Ca, P, S, Zn, Mn), available  $\text{PO}_4$ -P, cation exchange capacity (CEC), KCl extractable  $\text{NO}_3$ -N and  $\text{NH}_4$ -N and soil pH were determined. The nutrient stocks of the organic horizons, the upper mineral horizon (A horizon) and the lower mineral horizons (BC horizons) were calculated and were related to the production of plant biomass.

Exploratory data analyses applied gave account of a high diversity of the soil properties both among the organic horizons, upper and lower mineral horizons as well as among plantations. These results highlight that pine plantations have been established on sites with different soil nutrient potential. Thus, the planned forest management (thinning and underplanting with native species) will have different impacts on nutrient cycling and plant nutrition and will be assessed in further investigations.

**Merian Award Applicant**

## LOW-LEVEL N, P AND N+P AMENDMENTS TO A TROPICAL MONTANE FOREST IN ECUADOR: RESPONSE OF C AND N CYCLES DURING THE FIRST FIVE YEARS

Andre Velescu<sup>1</sup>, Jürgen Homeier<sup>2</sup>, Wolfgang Wilcke<sup>1</sup>

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<sup>2</sup>University of Göttingen, Institute of Plant Sciences, Göttingen, DE

In the tropical montane forest of southern Ecuador we observed a strong increase in N deposition during the past twelve years, which is also accompanied by reduced soil moisture. This increasing N input, which is mainly due to biomass burning, is expected to continue in the future and to have great impact on ecosystem functioning and services.

To understand the effects of nutrient inputs on this forest ecosystem, which belongs to the global biodiversity hotspots, an interdisciplinary nutrient manipulation experiment (NUMEX) was established in 2007 on the eastern cordillera of the Andes. During the past 5 years we have continuously applied 50 kg ha<sup>-1</sup> a<sup>-1</sup> of N, 10 kg ha<sup>-1</sup> a<sup>-1</sup> of P, 50 kg + 10 kg ha<sup>-1</sup> a<sup>-1</sup> of N and P in a randomized block design in the Reserva Biologica San Francisco at 2000 m a.s.l.

We observed an increased leaching of TOC and DON from the canopy as well as increased TOC/DON-ratios in throughfall in response to the N and N+P additions. At the same time, the TOC and DON concentrations were lower in the litter leachate originating from the organic layer of the plots with N+P additions than in the litter leachate of the plots where only N was added. Furthermore, more NH<sub>4</sub> and NO<sub>3</sub> were leached from the organic layer of the N plots than from the plots with N+P additions. This suggests that the combined addition of N and P leads to a more efficient use of the added N by the ecosystem.

In the mineral soil solution at 0.15 m depth, below the main rooting zone in the thick organic layer, our data shows higher leaching rates of TOC and DON to the subsoil of the plots with N+P and P additions than of the plots with N additions only. The soil solutions originating from all 3 treatments had higher concentrations of TOC and DON compared to the control plots. Furthermore, the soil solution of the N+P and P plots had higher concentrations of NH<sub>4</sub>, but lower concentrations of NO<sub>3</sub>. All observed responses indicate an enhanced microbial activity which seems to be more limited by P than by N. At 0.30 m mineral soil depth we identified a significant acidification trend of the soil solution in the control and N-addition plots, but not in the N+P and P plots suggesting that the deposited N can only be used by organisms if at the same time the P availability is improved. Otherwise, NO<sub>3</sub> will be leached and the acidity produced by nitrification remains in the soil.

**Merian Award Applicant**

THURSDAY 16:00



## EFFECTS OF NUTRIENT ADDITION ON FINE LITTER PRODUCTION AND LEAF PROPERTIES OF ECUADORIAN ANDEAN FORESTS

Jürgen Homeier<sup>1</sup>, Marion Schmelz<sup>1</sup>, Janine Waege<sup>1</sup>, Nohemy Poma<sup>3</sup>

<sup>1</sup>*Plant Ecology, University of Göttingen, Göttingen, DE, jhomeie@gwdg.de*

<sup>3</sup>*Universidad Nacinal de Loja, Loja, EC*

The effects of continued nutrient addition on tropical montane forest ecosystems is investigated in three Andean forest types at 1000m, 2000m and 3000m within the ongoing Ecuadorian NUtrient Manipulation EXperiment (NUMEX), that started in January 2008 (adding moderate amounts of N (50kg ha<sup>-1</sup> yr<sup>-1</sup>), P (10kg ha<sup>-1</sup> yr<sup>-1</sup>), and N and P to representative stands). We are monitoring fine litter mass and quality and leaf properties of common tree species since the start of the experiment.

Fine litter production was positively affected by N and N+P addition throughout all study years and elevations while P addition had only small or even negative effects. Several leaf traits are significantly altered by nutrient addition, responses are species-specific and highly depending on the study site.

THURSDAY 16:15

## TROPICAL MONTANE RAINFORESTS, A PRODUCTIVITY AND CARBON CYCLE ANALYSIS

Sebastian Paulick<sup>1</sup>, Claudia Dislich<sup>1,2</sup>, Andreas Huth<sup>1</sup>

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<sup>2</sup>*Department of Ecosystem Modeling, Buesgen-Institut, Georg-August-University, Goettingen, DE*

Tropical montane rainforests (TMF) have received less scientific attention compared to tropical lowland forests, and scientific knowledge of forest dynamics and carbon exchange of these forests is still limited. However, they play an important role in the global carbon cycle. In this context, dynamic and process-based forest models offer useful tools to improve our understanding of forest dynamics and to evaluate the sensitivity of TMFs to changes of environmental factors. In this study we apply the process-based forest gap model FORMIND to a montane forest in South Ecuador.

The objective of this study is to investigate how carbon fluxes and pools (deadwood and soil) in tropical montane forests are affected by changes in evapotranspiration. Finally, we compare the productivity data (Gross primary production and net primary production (GPP and NPP)) to existing measurements in other TMFs.

Our results show that compared to other tropical montane forests, we predict NPP quit well while underestimating soil respiration rates which influence the net ecosystem exchange. Our results for forest productivity for the Ecuadorian site compare well within the ranges of other tropical montane forests.

Process based forest models are a promising tool for simulating detailed forest carbon cycles which is particularly helpful in the absence of eddy covariance data.

THURSDAY 16:30



## SESSION 9:

### IMPACTS OF LAND USE ON ECOSYSTEMS: RESPONSES OF NATIVE BIOTA TO DIFFERENT FORMS OF LAND MANAGEMENT

[ Short title: Impacts of land use on ecosystems ]

Chairs: Julia Nowack, Joachim Nopper, Susanne Kobbe

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The concept of sustainability and sustainable land use are major components of large scale funding measures. The focus of these activities is to improve the livelihoods of people in combination with the conservation of natural ecosystems. In the symposium, we propose to compile reports from different land use projects in different parts of the tropics, to review to what extent biodiversity conservation is achieved by these projects, and to analyze, how native biota respond to different forms of land management. The goal of the symposium is to come to a better understanding of general patterns in the responses of native biota beyond the phenomena described by case studies.

THURSDAY 11:15



## LONG TERM EFFECTS OF LOGGING ON POPULATION STRUCTURES AND SPATIAL DISTRIBUTION OF DOMINANT MONTANE TREES ON MT. KILIMANJARO

Gemma Rutten<sup>1,†</sup>, Andreas Ensslin<sup>1</sup>, Andreas Hemp<sup>1</sup>, Markus Fischer<sup>1</sup>

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The forests of Mount Kilimanjaro in Tanzania have been subjected to a long history of selective logging. One of the most important timber species is the camphor tree *Ocotea usambarensis* (Lauraceae). It occurs roughly between 2000m and 3000m above sea level in the national park where logging is prohibited for over 50 years. In the lower range *Ocotea* occurs with *Xymalos monospora* (Monimiaceae), *Ilex mitis* (Aquifoliaceae), *Agauria salicifolia* (Ericaceae) and *Macaranga kilimandschari* (Euphorbiaceae). However in the upper range it is associated with *Podocarpus latifolius* (Podocarpaceae) and *Schefflera volkensii* (Araliaceae). Our goal was to assess patterns in the population structure and spatial distribution of *Ocotea* and its dominant co-occurring tree species in both natural and logged montane forests. We expected logged forests to have less size classes and more evenly distributed frequencies per size class compared to natural forests. Moreover, we expect the spatial pattern to be less regular in logged forests than in natural forests. Therefore, we mapped and measured the height and diameter at breast height (dbh) of all trees <10cm dbh on 10 plots of 0.25ha. Five plots covered the variation in natural *Ocotea* forests, another five the variation in logged *Ocotea* forest. We found 2152 trees of 34 species and 424 *Ocotea* individuals. We did not detect differences between logged and natural forests in frequencies per size class or number of size classes, not for the community structure nor for the structure of *Ocotea*. Moreover, the overall spatial distributions of trees (L-function) were random both in logged as well as in natural forests. Still, there was a significant but weak positive correlation between tree size and nearest-neighbor distance for the dominant species, independent of forest type. Moreover, we found non-random pairwise spatial patterns ( $L_{1,2}$ -function) between species and size classes depending on site. This suggests that population structure and spatial patterns are resulting variation across sites rather than from long term effects of logging.

**Merian Award Applicant**

THURSDAY 11:15



## THE END OF ROAMING IN THE FOREST CAUSES A LOSS OF TIMBER RESOURCES: THE PARADOX OF SLASH AND BURN AGRICULTURE

Julie Morin-Rivat<sup>1,2</sup>, Adeline Fayolle<sup>1</sup>, Charly Favier<sup>3</sup>, Laurent Bremond<sup>4</sup>, Sylvie Gourlet-Fleury<sup>5</sup>, Philippe Lejeune<sup>1</sup>, Hans Beeckman<sup>2</sup>, Jean-Louis Doucet<sup>1</sup>

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<sup>4</sup>EPHE - CBAE, Montpellier, FR

<sup>5</sup>CIRAD, Montpellier, FR

Tropical forests are not believed as pristine anymore. Their structure and specific composition are induced by past climatic and human disturbances over years. In the African moist forests, the emergent trees are mainly light-demanding. These trees are considered to derive from the recent disturbances of the last centuries. Most of them are exploited for their timber. However, several of these tree species are currently suffering from a lack of regeneration that threatens the specific diversity of the forests and the sustainability of timber exploitation. Through dendrometric and radiocarbon analyses we found that the majority of the trees of the Congo Basin are not older than 130 years. This corresponds to about the year 1880 when the Europeans colonized the inner regions of Central Africa. By reassembling people along the road axes, the colonial administration reduced the forest roaming. Former activities such as slash and burn agriculture created large openings in the canopy that allowed light-demanding tree species to establish. Currently we observed that timber logging does not provide openings large enough for the recruitment of these species. We thus anticipate that adjustments in forest management strategies shall be made to preserve the forest resources, for instance by recreating the conditions of slash and burn agriculture.

**Merian Award Applicant**

THURSDAY 11:30

## UNDERSTANDING THE RESILIENCE OF TROPICAL PRODUCTION FOREST: THE CONTRIBUTION OF A NEW PAN-TROPICAL FOREST OBSERVATORY

Plinio Sist<sup>1</sup>, Ervan Rutishauser<sup>1</sup>

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To date, about two third of the world forests are estimated to be affected by human activities and disturbances (FAO 2010). In the Tropics, about half of the total area (400 million hectares) has been designated as 'production forests' and have or will be logged in the future. Managed forests will hence play an increasing role in the provision of ecosystems services in the coming decades. It is generally accepted that ecological and economic viabilities of tropical forests can be met through sustainable management. However, the long-term impact of current harvesting practices on ecosystem services remains poorly known. We present here the first pan-Tropical managed Forest Observatory ([tmfo.org](http://tmfo.org)) that spread over the three main tropical regions (Amazon, Congo Basin and South East Asia). TmFO is assessing the resilience of logged-over forests in the context of climate change and strong human pressure on forest resources in order to define the best forest management practices, concealing economic benefits and maintenance of environmental services. We will present preliminary results of biomass recovery after logging from 243 plots covering c. 820 ha in the Amazon basin.

THURSDAY 11:45



## ENVIRONMENTAL AND ANTHROPOGENIC DRIVERS OF PLANT DIVERSITY AND TREE POPULATION ECOLOGY IN GRAZED CAATINGA DRY FORESTS OF NE BRAZIL

Katharina Schulz<sup>1,2</sup>, Jarcilene de Almeida Cortez<sup>3</sup>, Ingo Kowarik<sup>1,2</sup>, Arne Cierjacks<sup>1,4</sup>

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<sup>3</sup>Centro de Ciências Biológicas, Departamento de Botânica, Universidade Federal de Pernambuco, Recife, BR

<sup>4</sup>Biozentrum Klein Flottbek, Biodiversity of Crop Plants and Agroecosystems, University of Hamburg, Hamburg, DE, arne.cierjacks@uni-hamburg.de

Caatinga dry forests of NE Brazil are characterized by high floristic diversity and endemism. The majority of these forests are subjected to grazing by domestic ungulates which may deteriorate ecosystem composition and functioning. To assess the impacts of the present land use system on biodiversity, we analyzed plant species richness and the population structure of dominant tree species in relation to grazing intensity and environmental gradients on 45 study plots in the surrounding of Itaparica Reservoir, Pernambuco, Brazil. The study was part of the BMBF-funded INNOVATE project which aims to develop innovative, sustainable land use strategies in the area. Our data revealed that the number of woody species significantly decreased with increasing grazing intensity. In contrast, species number increased with altitude a.s.l. The population structure of the most frequent tree species showed a J-shaped diameter distribution with most individuals in the smallest stem diameter class (<10 cm), even at sites with high grazing pressure. This indicates sufficient recruitment to maintain the current vegetation cover. However, in *Spondias tuberosa*, a tree species of high economic relevance on the local market, the population exclusively comprised old trees and recruitment via seedling or asexual ramets was completely absent. The results imply that the current grazing regime does not negatively influence the more frequent species despite the overall reduction in species richness. Still, vulnerable or regeneration-limited species such as *S. tuberosa* require specific protection measures (enrichment planting, grazing exclosure to thrive under the present land use system.

THURSDAY 12:00



## NOT ALL LOGGED FORESTS ARE THE SAME: IDENTIFYING THRESHOLDS OF LOGGING INTENSITY FOR MAINTAINING TROPICAL FOREST BIODIVERSITY

Zuzana Burivalova<sup>1</sup>, Lian Pin Koh<sup>1</sup>

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The most common cause of tropical forest degradation is selective logging. Yet, the impacts of selective logging on biodiversity remain poorly understood, in part due to the seemingly conflicting findings of case studies: about as many studies have reported increases and decreases in biodiversity following selective logging. Through a pantropical meta-analysis and using an information-theoretic approach, we tested alternative hypotheses for key predictors of the impacts of selective logging on invertebrates, amphibians, birds and mammals. The predictors we considered include i) logging intensity, ii) time since last selective logging event; iii) area of logged forest parcel; iv) total area of forest fragment; v) distance to nearest primary forest; vi) geographic location; and vii) taxonomic group. The two most parsimonious models we identified indicate that logging intensity best predicts changes in species richness due to selective logging; and the effect of logging intensity varies with taxonomic group and continental location. Mammals and amphibians are the most sensitive groups to selective logging, and suffer a halving of species richness at logging intensities of 38 m<sup>3</sup> ha<sup>-1</sup> and 63 m<sup>3</sup> ha<sup>-1</sup>, respectively. A better understanding of the nuanced responses of species along a gradient of logging intensity could help inform evidence-based sustainable logging practices from the perspective of biodiversity conservation.

**Merian Award Applicant**

THURSDAY 14:45

## FUNCTIONAL AND PHYLOGENETIC DIVERSITY OF SCATTERED TREES IN AGRICULTURAL LANDSCAPE: IMPLICATIONS FOR CONSERVATION AND MANAGEMENT

Eduardo Athayde<sup>1</sup>, Leonardo Cancian<sup>2</sup>, Luciano Verdade<sup>3</sup>, Patricia Morellato<sup>1</sup>

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Scattered trees are a remarkable feature of the matrix of agricultural landscapes, but few studies have addressed their role to the conservation of the biodiversity. In this study we aim to investigate what is the value of scattered trees to maintain the functional and phylogenetic diversity within the matrix of an agricultural landscape dominated by commercial eucalyptus plantation. We established a grid of cells in UTM 100 x 100 m covering the fullest extent of our target farm. We conducted an inventory and georeferenced all scattered trees present within each cell in the grid. We marked 2667 cells, out of these 269 had scattered trees and were used in further analysis. We mapped the spatial distribution of taxonomic, functional and phylogenetic diversity of scattered trees and compared to the diversity of sampled remnant areas of native vegetation in the farm to access how the different facets of diversity were preserved in this agricultural landscape. Scattered trees presented a lower taxonomic, phylogenetic and functional diversity than the native vegetation nearby and these diversity indices were strongly related to local species richness. However, the scattered trees would be able to keep on average 64% and 85% of the total functional and phylogenetic diversity in agricultural land use, respectively. Further, the scattered trees maintained a functional and phylogenetic diversity greater than expected by chance. Scattered trees in the landscape are unprotected by environmental laws since they are not included in or are part of the network of protected areas. We demonstrate here the importance of conservation of scattered trees to maintain moderate levels of phylogenetic and functional diversity in anthropogenic matrix, counteracting the loss of species that occurs in highly productive landscapes and mitigating the effect of homogenization of agricultural landscape. (Financial support: FAPESP, CNPq)

**Merian Award Applicant**

THURSDAY 15:00



## EPIPHYTIC ORCHIDS IN A LAND USE GRADIENT IN THE HIMALAYAS, NEPAL

Yagya Adhikari<sup>1</sup>, Anton Fischer<sup>1</sup>

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Land use change is one of the major drivers for forest and biodiversity loss. This is especially true for tropical and subtropical forest ecosystems. We studied the effects of human land use (protected forest, managed forest, agriculture, settlement up to densely settled city centre) on epiphytic orchids with respect to host species and their characteristics micro-site conditions in an land use intensity gradient from protected forest (national park) to city centre in Kathmandu Valley, Nepal. We established a 1.5 km grid net and analysed the epiphytic orchids growing on trees next to the 156 regularly distributed grid points (10 trees each as close as possible to the respective point). Remote sensing data were used for classification of land use types and intensities. In urban areas, *Ficus religiosa* turned out to be the most important host tree species for epiphytic orchids, while *Schima wallichii* and *Alnus nepalensis* significantly host orchids in the other categories. Host bark pH, bark rugosity, sunlight intensity and host exposure to wind are important microsite parameters explaining epiphytic orchids' diversity. Both species richness and abundance of epiphytic orchids were significantly higher under very low human impact and also some remaining patches of primary forest than the other regions. Nevertheless about 18 % and 9 % of the epiphytic orchid species survive also under strong and very strong human impact, respectively, at least with small populations.

We developed a general concept for the conservation of epiphytic orchids in rural and urban areas in the (sub-) tropics. It includes: i) protection of still existing forest patches close to the expanding cities, ii) protection of small groups or single trees still existing in rural and urban areas, iii) planting new trees (preferably from native species) to give orchids a chance to settle in the area in the future ("trees for the future"), and iv) to develop public awareness that trees (and the plants and animals living in their canopies) are a natural and national heritage and therefore should be protected.

**Merian Award Applicant**



## EFFECTS OF TRADITIONAL LAND USE ON DIVERSITY PATTERNS OF INVERTEBRATES AND PLANTS ON THE SEMI-ARID MAHAFALY PLATEAU (SW-MADAGASCAR)

Roman Fricke<sup>1</sup>, Lars Opgenoorth<sup>1</sup>, Roland Brandl<sup>1</sup>

<sup>1</sup>*Philipps University, Marburg, DE, roman.fricke@biologie.uni-marburg.de*

The Mahafaly Plateau is characterized by a high level of local endemism in plants and animals. The natural vegetation would be diverse deciduous spiny forest, but poverty and fast population growth lead to increased natural resources exploitation by the local population. Together with climate change, these altered land use dynamics result in highly degraded ecosystems. Relatively undisturbed forests are almost entirely restricted to the local National Park while the Mahafaly Plateau's principle part is now dominated by anthropogenic half-open and open landscapes.

We analysed data of >100 plots from 15 villages, located within three different land use types (crop fields, pastures and woods) with varying land use intensity. Soil and vegetation parameters were assessed and both plant and invertebrate animal communities were sampled.

Our results prove effects of ecosystem degradation on multiple ecosystem properties. Soil characteristics are highly influenced by both land use type and land use intensity, especially soil carbon and nitrogen content. Land use directly affected canopy cover and litter layer, thus altering micro-climatic conditions for plants and animals. While species richness of plants decreased with degradation, the average proportion of alien plant species increased from <5 % in densely forested pastures towards >50 % on crop fields. Faunal diversity also decreased with habitat degradation for most animal groups. However, in some groups (e.g. ants), species richness was not affected but species assemblies became more homogenous with increasing degradation. Overall, we found pronounced effects of habitat degradation on all the ecosystem properties analysed, but the characteristics of these relations differed.

We conclude that, substantial parts of the natural communities are highly sensitive to habitat degradation, although the mechanisms differ among groups. Even though local land use practices are very extensive, the degraded ecosystems that replace the original forests are not capable of preserving a considerable part of the indigenous biodiversity and also probably the ecosystem services that the local people rely on. Thus, our findings emphasize both the need for effectively protected forests and the establishment of more sustainable land use practices on the Mahafaly Plateau.

**Merian Award Applicant**

THURSDAY 16:00



## THE IMPACTS OF LOGGING AND OIL PALM AGRICULTURE ON STREAM INVERTEBRATES IN MALAYSIAN BORNEO: CAN RIPARIAN MARGINS MITIGATE THE LOSS OF BIODIVERSITY?

Sarah H Luke<sup>1</sup>, Rory Dow<sup>2</sup>, Holly Barclay<sup>1,3</sup>, David C Aldridge<sup>1</sup>, William A Foster<sup>1</sup>

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Freshwaters provide essential ecosystem services, and comprise highly biodiverse habitats, but are heavily threatened by land use change. In Southeast Asia, tropical rainforest stream ecosystems are being impacted by rapid expansion of logging activities and growth of oil palm agriculture causing changes in inputs of sediment, nutrients and flow. These changes may substantially impact biodiversity, ecosystem function and consequent provision of services, but research has been limited, and there has been little testing of strategies for mitigating logging and oil palm agriculture effects.

Our work at the Stability of Altered Forest Ecosystems (SAFE) Project, in Sabah Malaysia, tests the effects of catchment logging and oil palm plantations on stream macroinvertebrate assemblages, and the value of riparian forest margins for protecting stream ecosystems from disturbance. Macroinvertebrates form a major part of the freshwater biota and changes in their assemblages are likely to have significant impacts on ecosystem function. We surveyed benthic insect larvae, surface skater bugs, large shredders/grazers (crabs, shrimps, snails), and adult dragonflies across streams with a range of catchment forest quality and oil palm. We found that diversity and abundance of many macroinvertebrate groups was reduced in low quality forest and oil palm catchments, however dragonflies remained abundant and species rich. However, this richness was maintained through a shift in community composition, rather than all species surviving the disturbance – many forest specialists and locally restricted species were lost from disturbed streams.

This shows that recent logging and oil palm land use change in Malaysian Borneo, and likely wider Southeast Asian tropical forests, has significant impacts on macroinvertebrate communities, and particularly on specialists. Strategies such as riparian forest margins must be developed to maintain freshwater ecosystems and unique biodiversity, in the face of expanding agriculture.

**Merian Award Applicant**

THURSDAY 16:15

## EFFECTS OF ANTHROPOGENIC DISTURBANCES ON AMPHIBIAN DIVERSITY IN TROPICAL RAINFORESTS

Julian Glos<sup>1</sup>, Jana Riemann<sup>1</sup>, Serge Ndriantsoa<sup>2</sup>, André Jankowski<sup>1</sup>, Raquel Brofman<sup>1</sup>, Alexander Haas<sup>1</sup>, Mark-Oliver Rödel<sup>3</sup>

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Tropical rainforests are severely influenced by anthropogenic habitat alterations such as deforestation, degradation and fragmentation. Although in general these disturbances of natural ecosystems are thought to have negative effects on biodiversity, there is no consistent pattern on species' and communities' reactions and therefore, ecosystem consequences remain poorly known. Usually, not all species react in the same way to disturbances. Differences in species' extinction susceptibilities may result in changes in community structures and food-web interactions, and hence ecosystem functioning. A species' susceptibility to extinction depends on the species' specific traits. Hence, understanding disturbance effects on functional diversity is crucial for understanding potential ecosystem consequences and future conservation efforts. We aim at understanding patterns of species richness and functional diversity, and identifying traits that predispose for local extinctions in two disturbed rainforest ecosystems: the Ranomafana area in Madagascar (deforestation, fragmentation) and Harapan Rainforest in Sumatra (selective logging, oil palm plantation). We here focus on conclusive results for the Madagascan system, and extend these with preliminary results for the Indonesian system. In the Madagascan system, we determined different aspects of diversity, i.e., species richness, community composition, functional diversity and genetic diversity, and analyzed differences on a gradient of four major habitat types (continuous forest, forest fragments, two matrix habitats), and between two subsets of amphibian communities (stream habitat and terrestrial habitat). In general, disturbance effects on diversity were weak. For stream habitat amphibians, both forest fragments and matrix habitat were similar to the continuous forest in all aspects of diversity but species composition, indicating a replacement of species by functionally similar species in disturbed sites. Amphibian communities in terrestrial habitat, however, were less diverse in matrix habitats than in continuous forest and fragments with no difference between continuous and fragmented forest. We conclude that disturbed habitats in Madagascar are important refuges of amphibian diversity, and we discuss the exposure to high natural disturbances (e.g., cyclones) as a factor that predisposes the resilience of Madagascan amphibians to anthropogenic disturbances.

THURSDAY 16:30



## CONSERVATION OF THE GULF OF GUINEA HIGHLANDS FROM A BUTTERFLY PERSPECTIVE

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The Gulf of Guinea Highlands, the only large mountains in West/Central Africa, represent a centre of endemism and tremendous conservation importance on a global scale. Currently, the majority of this area is covered by mosaics of Afromontane forest remnants, areas significantly altered by humans, and a variety of habitats between these two extremes. Practically all recent conservation activities focus on patches of continuous forests, which were recently shown as potentially insufficient for some endemic butterflies. Simultaneously, some of the already protected areas are under intensive human impact and their long-term sustainability is unrealistic. For more effective conservation planning, we analysed communities of specialised submontane butterflies, a group containing a considerable number of endemics. In our analyses, we combined species richness of individual localities, species-specific distribution patterns, and patterns of a genetic heterogeneity of selected submontane butterflies. As a result, localities with the highest conservation value were identified and their status, in relation to current land-use and potential socio-economic conflicts, could be considered.

**Merian Award Applicant**

THURSDAY 16:45

## RUBBER VERSUS ELEPHANTS: CONFLICTS OF HUMAN LAND-USE AND WILDLIFE HABITAT IN SOUTHERN THAILAND

Franziska K. Harich<sup>1</sup>, Anna C. Treydte<sup>1</sup>, Tommaso Savini<sup>2</sup>, Chution Savini<sup>3</sup>, Kenneth K.Y. Aidoo<sup>1</sup>, Mi J. Im<sup>1</sup>

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Conflicts between humans and wildlife have rapidly increased in numbers over the last decades. This increase is mainly due to a rising human population and subsequently expanding areas of human land-use. Rubber plantations in particular replace more and more ecologically important forests throughout Southeast Asia. This expansion leads to increasing crop raiding and destruction by wildlife, mainly elephants (*Elephas maximus*), evoking a negative attitude of humans towards wildlife and their protective status. Although rubber is an important and abundant cash crop for many farmers in Southeast Asia, few studies have yet investigated rubber-related conflicts with elephants and appropriate management techniques. We interviewed 180 farmers living around the Tai Rom Yen National Park in Southern Thailand on the extent of conflicts with wildlife and the impacts on farmers' livelihoods as well as their attitude towards wildlife conservation using semi-structured questionnaires. Wildlife damage was not as much a concern as damage through diseases or insects but still 37% of respondents reported damage caused by wildlife. Among them, 53% experienced damage due to elephants although it was squirrels (*Sciuridae* spec.) that were seen most often on farmland (58% of interviewed farmers). For several wildlife species more visits in diversified farming systems compared to monoculture plantations were recorded, however not for elephants. Farmers who cultivated different crops had a higher income than farmers with monoculture cultivations, potentially making it easier for them to cope with some losses due to wildlife. More than 90% of damage in rubber cultivations occurred in rubber seedlings and saplings while older plantations were hardly susceptible to wildlife damage. Prevention measures should therefore focus on protecting young plantations of rubber.

FRIDAY 09:15



## LEASE, LAND- USE AND LIVELIHOODS - A MALAYSIAN OIL PALM SCHEME AND ITS SOCIAL AND ECOLOGICAL IMPACTS

Nico Wilms-Posen<sup>1</sup>, Mali Boomkens<sup>2</sup>, Sarah d'Appolonia<sup>1</sup>, Eva Maria Krauss<sup>1</sup>, Amanda Klarer<sup>2</sup>, Lena Lyngholt Tynell<sup>1</sup>

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Over the past 40 years, investments in cash crop cultivation, such as oil palm plantations, induced significant land use in Sarawak, Malaysia. These changes have various impacts on ecosystems and livelihood security of rural households. This study investigates the impacts of a state-supported oil palm scheme (SALCRA) on livelihood security and the environment in an integrated manner. The multifaceted question is addressed through an interdisciplinary approach applying both social and natural science inquiries and recognizing the observed dichotomy between the protection of ecosystems and oil palm cultivation in the region. In a first step, the fieldwork covered the perceived environmental effects of the land-use change and investigated effects of the scheme on household's income portfolio diversification. We find that diversification occurs through direct and indirect pathways. Despite the income diversification and the positive perceived effects on income levels of SALCRA in the study area, concerns about the environmental sustainability of the oil palm development have been expressed regarding soil quality. In a second step, the research therefore consequently aimed to investigate this issue. Soil analysis included measurement of active carbon levels. The results partly support the general perception of the villagers. They provide however a more differentiated picture as the impact of the plantations on soil quality is found to be largely dependent on applied management practices.

In conclusion, SALCRA can be said to have a positive impact on livelihoods of most villagers at the moment. It has however to be ensured that the current positive effects are not jeopardizing livelihood opportunities for future generations through negative impacts on soil quality. Not only financial, but also environmental sustainability of the SALCRA scheme should be addressed to ensure that future generations are provided with livelihood opportunities in the study area.

**Merian Award Applicant**

## UNDERSTANDING VEGETATION CHANGES IN THE ATLANTIC RAINFOREST - MULTIVARIATE ANALYSIS COMPARING PRE-COLONIAL AND PRESENT POLLEN SAMPLES

Jackson Rodrigues<sup>1</sup>, Thomas Giesecke<sup>1</sup>, Nele Jantz<sup>1</sup>, Hermann Behling<sup>1</sup>

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The Atlantic Rainforest is one of the richest biomes in the world, as it covers approximately 1.315.460 km<sup>2</sup> and is departed among Paraguay, Argentina and Brazil. However, it has been suffering strong changes due to human activities. For this reason, the aim of this study is to identify and quantify vegetation changes at 27 sites distributed in the Atlantic Rainforest by comparing pollen samples of the pre-colonial period with surface pollen samples representing the current vegetation. Multivariate analyses was used to explore the correlation of pollen data of each site with climatic variables and to identify patterns in changes of vegetation composition. The comparison of pre-colonial with surface samples based on Square chord Distance (range from 0 to 2) shows strong changes in the pollen taxa composition of all sites, with variations between 0.19 and 1.10. This pattern can also be observed when comparing the PCA (Principal Components Analysis) of the pre-colonial period with the one of the surface samples. Whereas the pre-colonial data shows sites with similar taxonomic composition arranged according to the variation of ecosystems, surface data indicates that sites of different ecosystems are closer together, this being an indication of vegetation changes. These changes occurred due to logging in the early centuries of colonization and subsequent cattle farming and plantations which induced the increase in herbs, like Poaceae and Asteraceae, and the decrease in trees, such as *Caesalpinia echinata* and *Araucaria angustifolia*, in areas originally covered by *Araucaria* Forest and broadleaved forest in southern and southeastern Brazil, respectively. The comparison of PCA of the pre-colonial with the one of climatic variables shows that the dispersal of the vegetation is highly related to the distribution of climatic variables. In summary, multivariate analysis well represented the patterns of vegetation and its correlation with climate and also gave a reliable quantitative indicator of vegetation changes.

**Merian Award Applicant**

FRIDAY 09:45



## EVALUATION OF LAND USE CHANGE AND CLIMATE VARIABILITY IN EKITI AREA OF NIGERIA

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The proximate and underlying factors of landuse change include urbanization, agricultural expansion, deforestation and demographic changes which have contributed to the increase in the concentration of CO<sub>2</sub> and other green house gases in the atmosphere. The increase in concentration of greenhouse gases has altered the land and atmospheric interaction leading to global warming and a change in the earth surface and atmospheric energy balance. The landuse practices in some part of the world have led to continued fragmentation of landscape more and more. The changes in the landuse pattern resulting from human activities can significantly affect local, regional and global climate through shifts in the radiation, cloudiness and surface roughness, surface albedo and surface temperature.

Ekiti State lies within the forest vegetation zone of Nigeria and bounded in the north by guinea savanna. The people are mainly food and tree crops farmers, however, the area is fast turning to derived savanna as there is declining in the yield of tree crops and deforestation process on the increase. This could be attributed to the increase human activities which include urbanization, agricultural expansion, lumbering and change in the characteristics of the main climatic parameters. Also, in recent times, the area has become the abode of the cattle herders from savanna zone leading to incessant conflict over grazing area and farm land. This paper is to examine the impacts of landuse change on the climate of Ekiti state, SW part of Nigeria by assessing the change in the landuse patterns within the area for period between 1960 and 2005, to evaluate rainfall variability and also, establish a relationship between landuse and rainfall variability of the area within the period under study using multivariate statistical tools, GIS and satellite based technological approach. The study predicted that forest area will lose 32% in 2050, 47% and 27% increase in the rate of urbanization and agricultural expansion in the future respectively. All these account together with climatic variability to drive the processes of landuse/ landcover change within the study area.



## CLIMATE CHANGE, POVERTY AND LIVELIHOOD: THE CURRENT CHALLENGES OF RURAL COMMUNITIES IN THE ANDES

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Climate change is one of the major contributing factors for degradation of ecological services, and these in turn are harming many rural people and causing poverty in tropical mountainous regions. There is increasing evidence that climate change tends to be more severe, where people rely on weather dependent rain-fed agriculture for their livelihoods. This research is based on a case study of two Andean regions in Bolivia: highland and interandean valley. It explores how climate change is affecting the livelihood of local communities and how diverse wellbeing groups are impacted. Using a climate vulnerability and capacity analysis process (CVCA), livelihood profiles and environmental factors were analyzed; furthermore this study explores the incidence of poverty and livelihood strategies. The principal component and cluster analysis revealed three wellbeing groups in the population, based on natural, physical, human, financial, and social resources. The impact assessment of extreme weather events shows no significant differences between groups, but the livelihood strategies implemented by the households on each cluster are different. Finally, this study provides a preliminary assessment to which extent Andean rural communities are vulnerable to climate change and shows a complex set of interacting environmental, economic and social factors contributing to their vulnerability.

FRIDAY 10:15



## SUSTAINABLE LAND MANAGEMENT IN IRRIGATED RICE LANDSCAPES IN SOUTH-EAST ASIA - THE LEGATO PROJECT

Josef Settele<sup>1</sup>

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LEGATO stands for 'Land-use intensity and Ecological Engineering – Assessment Tools for risks and Opportunities in irrigated rice based production systems' and aims to advance long-term sustainable development of irrigated rice landscapes, against risks arising from multiple aspects of global change. The overall objective is the elaboration and testing of generally applicable principles within the frame of ecological engineering – an emerging discipline, concerned with design, monitoring and construction of ecosystems. Ecological engineering aims at developing strategies to maximize the ecosystem services through exploiting natural regulation mechanisms instead of suppressing them. A core component of this research project, which is part of the framework programme 'fona – Research for Sustainability', is to create the knowledge and decision-making base necessary for sustainable land management and also to provide the corresponding action strategies, technologies and systems solutions.

## A COMPARISON OF CHEMICAL AND SUSTAINABLE MANAGEMENT OF THE INVASIVE PEST SNAIL *POMACEA CANALICULATA* IN IRRIGATED RICE FIELDS IN SE-ASIA

Manfred Türke<sup>1</sup>, Janina Schneider<sup>1</sup>, Leonardo Marquez<sup>3</sup>, Ho Van Chien<sup>2</sup>, Jesus Viktor Bustamante<sup>5</sup>, Gertrudo Arida<sup>3</sup>, Nguyen Van Sinh<sup>4</sup>, Wolfgang W. Weisser<sup>1</sup>

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<sup>5</sup>Las Vegas, Banaue, PH

The invasive golden apple snail, *Pomacea canaliculata*, has become one of the most important pests in irrigated rice production in South-east Asia. Recommendations on how to control the pest snail include a variety of sustainable methods and the application of chemical molluscicides only if necessary. As molluscicides are the easiest way to control the pest they became popular with farmers, although molluscicides can have detrimental effects on the environment, non-target species and health. We wanted to assess the efficiency of either chemical or sustainable snail control by farmers and its impact on the native mollusk fauna.

We conducted interviews on golden apple snails with rice farmers from 7 regions in Vietnam and the Philippines varying in land-use intensity. We further sampled mollusks in 3 of these regions, including 1 region where no molluscicides are applied. Samples were taken in rice fields before snail control was applied (before rice planting) and directly after control (1 and 2 weeks after planting). Most farmers applied molluscicides, although they often had constraints about the toxicity of the chemicals. Many farmers, however, did not know of any effective, sustainable management methods. Farmers also noticed a decrease in the abundance and diversity of native snails. There were profound differences in pest snail biomass and biomass decrease by management among and within regions, but sustainable management often performed as good as chemical control. Abundance and diversity of native mollusks was much higher in the region where no chemical molluscicides were applied.

In conclusion, sustainable management of golden apple snails could be an alternative to the use of chemicals in order to reduce the impact on non-target organisms and the environment. As shifting the behavior of farmers is difficult, we suggest that sustainable snail control could be achieved more efficiently by specialized and trained local companies instead.

**Merian Award Applicant**

FRIDAY 12:00



## CHANGES IN PROPERTIES OF DIFFERENT TROPICAL SOILS EXPOSED TO PADDY MANAGEMENT

Angelika Kölbl<sup>1</sup>, Klaus Kaiser<sup>2</sup>, Livia Urbanski<sup>1</sup>, Peter Schad<sup>1</sup>, Pauline Geier<sup>2</sup>, Reinhold Jahn<sup>2</sup>, Andreas Hofmann<sup>3</sup>, Michael Schlöter<sup>3</sup>, Sri Rahayu Utami<sup>4</sup>, Zhi-Hong Cao<sup>5</sup>, Ingrid Kögel-Knabner<sup>1,6</sup>

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<sup>6</sup>Institute for Advanced Study, TU München, Garching, DE

Cultivation of rice under submerged conditions results in distinct soils (paddy soils). Paddy soils may originate from many different parent soil types. Management includes artificial submergence, ploughing, and puddling and cause a dense plough layer and redox-related transformation and re-distribution of minerals and soil organic matter (SOM) with depth. The present study aims at investigating the impact of paddy management on mineral assemblage, SOM, and microbial (enzyme) activity as compared with agricultural soils not used for paddy rice production.

The study focuses on major soil types typically used for rice cultivation in Asia, including Acrisols (sub-tropical monsoon climate, PR China) as well as Andosols, Vertisols, and Ferralsols (tropical climate, Java, Indonesia). Paddy soils as well as adjacent agricultural soils not used for paddy rice production (non-paddy soils) were sampled and analysed for bulk density, pH, organic carbon (OC) and total nitrogen, microbial activity, oxalate- as well as dithionite-citrate-bicarbonate-extractable Fe.

Paddy soils derived from Acrisols (PR China) were characterised by larger OC concentrations in the puddled topsoil horizons, resulting in larger cumulative OC stocks in paddy soils than in the respective non-paddy soils. In contrast, paddy soils derived from Ferralsols and Vertisols of Java had similar OC concentrations and stocks as the respective non-paddy soils. The (potential) microbial activity reflects the different OC concentrations of the different soil types, but shows only minor management-related differences. However, rice production under submerged conditions alters redox-sensitive constituents such as iron oxides. Paddy management always caused significant depletion of crystalline Fe oxides in the topsoils (puddled horizon and plough pan), often followed by accumulation of crystalline oxides in deeper horizons. Parts of the changes are linked to the properties of the original soil type. To conclude, the original soil types control direction and extent of the development of paddy soils.

FRIDAY 12:15



## SESSION 10:

### TROPICAL MYCOLOGY AND BIODIVERSITY

[ Short title: Tropical mycology and biodiversity ]

Chair: Prof. Dr. Gerhard Kost

Contact: [Kost@biologie.uni-marburg.de](mailto:Kost@biologie.uni-marburg.de)

Fungi are important members in the nutrient cycle of tropical ecosystems, but the knowledge about the biodiversity of the Fungi is insufficient. Using molecular techniques it will be studied selected taxa, which play quite different roles within the tropical ecosystem. Some of them live in mutualistic interactions, others are phytopathogenic species, and many fungal species decompose the produced biomass. In the proposed session all these different aspects should be discussed and new information will be presented.

FRIDAY 09:15

## SPECIES' RANGES, ABUNDANCE AND SPECIALIZATION

David Schellenberger Costa<sup>1</sup>, Michael Kleyer<sup>1</sup>, Markus Fischer<sup>2</sup>, Andreas Hemp<sup>3</sup>

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<sup>2</sup>University of Bern, Bern, CH

<sup>3</sup>University of Bayreuth, Bayreuth, DE

Following Hutchinson's niche definition, species can survive in habitats with environmental conditions included in their realized niche. Species with small breadths in relation to an environmental variable are often classified as being specialists, in contrast to generalists, that exemplify a larger tolerance towards varying environmental conditions and have thus a larger niche breadth. Apart from being specialists or generalists, some species have a high cover, i.e. are dominant in particular habitats they live in, while others have a low cover being subordinate or rare. Assuming equal minimum population sizes and space requirements, generalists should have more possibilities on the dominance-subordination gradient than specialists: Species with small niche breadths need to pack their entire population into a small number of habitats, while generalists can occur in high or low numbers in all habitats, as even low numbers would ensure survival through occurrences in a large amount of places.

Taking into account adaptation through evolution and changes in environmental conditions, the reality about specialists may be different: If formerly non-existent habitat conditions appear, no species may be able to cope with those. As soon as a species achieves to establish itself, it may have a large niche breadth including its old and new habitats. Nevertheless, being the only species to survive in the particular place, it should well be considered a specialist.

We make use of a dataset from Mt Kilimanjaro, Tanzania, comprising roughly 1800 species in 1000 vegetation surveys together with information on elevation, precipitation and disturbance. We ask

- (1) whether there is a general trade-off between niche breadth and abundance, i.e. cover,
- (2) if niche breadth is linked to specialization, i.e. if species with small niche breadths occur in stressful habitats, and
- (3) if functional traits sampled for a subset of the species can be used to predict occurrence along the gradients of elevation, precipitation and disturbance and/or niche breadths.

### Merian Award Applicant

FRIDAY 09:15



## PATTERNS OF LOCAL SPECIES RICHNESS IN A TROPICAL FOREST

Martin Kazmierczak<sup>1</sup>, Andreas Huth<sup>1</sup>

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In the last decades, detailed long-term data about tropical forests has become available. Yet, due to the complexity of these ecosystems, the governing processes shaping these forests still are unclear. By applying a local, grid-based analysis to data from a tropical forest in Panama, we show that there are distinct and discernible patterns in the structure and the dynamics of this forest and that there are strong relationships between important characteristics like abundance, species number and their development over time.

We compare this field-data to a null-model and discuss our findings in the light of MacArthur's Island Theory as well as Hubbel's Neutral Theory.

**Merian Award Applicant**

FRIDAY 09:30



## DEEP DNA SEQUENCING OF FUNGAL COMMUNITIES IN THE ANDEAN YUNGAS REVEALS HIGH DIVERSITY AND STRONG STRUCTURING AMONG ALTITUDINAL FOREST TYPES

József Geml<sup>1</sup>, Nicolás Pastor<sup>2</sup>, Lisandro Fernandez<sup>2</sup>, Silvia Pacheco<sup>3</sup>, Tatiana Semenova<sup>1</sup>, Eduardo Nouhra<sup>2</sup>

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<sup>2</sup>Instituto Multidisciplinario de Biología Vegetal (CONICET), Universidad Nacional de Córdoba, Córdoba, AR

<sup>3</sup>Fundación ProYungas, Yerba Buena, AR

The Yungas, a system of subtropical montane forests on the eastern slopes of the Andes, are extremely diverse and severely threatened by anthropogenic pressure and climate change. Previous mycological works in the Argentine Yungas focused on macrofungi (e.g., agarics, polypores) and mycorrhizae in *Alnus acuminata* forests, while fungal diversity in most of the Yungas has remained mostly unexplored. We carried out Ion Torrent sequencing of ITS2 rDNA from soil samples taken at 24 sites along the entire latitudinal extent of the Yungas in Argentina (appr. S 22.2–27.4°). The sampled sites represent the three altitudinal forest types: the piedmont (400–700 m asl), montane (700–1500 m asl), and montane cloud (1500–3000 m asl) forests. Based on our deep sequence data (i.e. analyzing 51 264 reads per sample following quality filtering and subsampling to equal sequencing depth), we delimited 14 039 non-singleton 97% sequence similarity fungal operational taxonomic units (OTUs). NMDS analyses suggested that fungal community composition correlated most strongly with altitudinal forest type ( $P=0.00002$ ), with many OTUs showing strong preference for a certain altitudinal zone. For example, ectomycorrhizal and root endophytic fungi were far more diverse in the montane cloud forests, particularly at sites dominated by *Alnus acuminata*, while the diversity values of various saprobic fungal groups were highest at lower elevations. Despite the strong altitudinal structuring, fungal diversity were comparable across the different zonal forest types. In addition, fungal community structure correlated with latitude in a somewhat weaker, but still significant ( $P=0.0007$ ) manner. Besides elevation, soil pH, N, P, and organic matter contents strongly correlated with fungal community structure as well, although most of these variables were co-correlated with elevation and forest type. Our data offer an unprecedented insight into the high diversity and spatial distribution of fungi in the Yungas forests.

FRIDAY 09:45



## FUNGAL PHYLOGEOGRAPHY AND BIODIVERSITY OF YUNNAN (CHINA)

Gerhard Kost<sup>1</sup>, Flavius Popa<sup>1</sup>, Zhu-Liang Yang<sup>2</sup>

<sup>1</sup>*University of Marburg, Marburg, DE*

<sup>2</sup>*Kunming Institute of Botany, Kunming, CN*

The province Yunnan in Southwest China is famous for a high habitat diversity and a high biodiversity. From virgin tropical lowland forests in the South to the more than 6000 m high mountains in the North, all kind of ecological niches can be found. Therefore, Yunnan is one of the most important biodiversity hotspots in Asia. Estimates by Yang (2005) indicate that about 40% of the 10.000 fungal species known from China are occurring here. A brief overview of the fungal biodiversity of Yunnan and biogeographic links to other areas were given.

In the past many common fungi from Europe were identified worldwide across all ecosystem types. This has led to the assumption that these fungi show a worldwide distribution. In 1934 Baas-Becking hypothesized for microorganisms: "Everything is everywhere, but, the environment selects". Though, in recent years molecular and detailed morphological studies revealed that specimen labeled with one species name encompass hidden species with limited areas of distribution. Based on recent studies and the results of our investigations in Yunnan we present examples of morphologically similar fungal species of different regions.

In 2013 the long standing cooperation between the University of Marburg and the Kunming Institute of Botany (KIB) in Yunnan was intensified by starting the IPF-Project (Integrative Fungal Research - LOEWE Research Cluster).

**Merian Award Applicant**

FRIDAY 10:00

## PHYLOGEOGRAPHIC PATTERNS OF NEOTROPICAL RUST FUNGI ON ANNONACEAE

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Species of the rust fungal genera *Phakopsora* and *Dasyscypha* occur on Annonaceae in the Neotropics. Five *Phakopsora* spp. are found on the genus *Annona* and eleven *Dasyscypha* spp. on *Xylopia*, respectively. Both genera show analogies between their phylogeographic patterns:

- There are sister species in both genera that are morphologically distinct but have identical ITS sequences. *Phakopsora pistila* occurs in humid Central America northern South America whereas *P. crucis-filii* occurs in savanna like habitats of French Guiana and Brazil. *Dasyscypha gregaria* from the Guianas and *D. echinata* from the cerrados of Brazil show a similar distribution pattern
- In contrast, the species *P. rollinae* and *D. nitida*, respectively, are split each in two subgroups with distinct ITS sequences. Both occur in the Guianas.
- Cryptic species are quite indistinguishable by morphology but belong to several phylogenetic lineages. Such cryptic species are *P. rollinae* and *P. annonae-sylvaticae*, respectively, *D. mesoamericana* and *D. frutescentis*.

Because the evolution of plant pathogens cannot explain independently from their hosts, the phylogeographies of *Annona* and *Xylopia*, respectively, are compared with them of the fungi.

The results of the study may indicate parallel evolution of both fungal genera, each together with its host genus, driven by common influences of historical geomorphological processes and climatic changes in the Neotropics.



## ELEVATIONAL PATTERNS OF TREE DIVERSITY, ENDEMISM AND PHYTOGEOGRAPHICAL AFFINITIES IN MOUNTAIN RAIN FORESTS OF CENTRAL SULAWESI, INDONESIA

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Tropical rain forests are well-known for their enormous plant diversity and in addition to high on-site diversity tropical mountain rain forests show high species-turnover along elevational gradients. Beside ecological factors, the pool of available species influences community composition at a given site. We studied patterns of tree species diversity along an elevational transect in old-growth moist tropical forests in Lore Lindu National Park of Central Sulawesi, Indonesia.

Diversity was assessed conducting plot-based inventories at 13 sites (each 0.24 ha-plots) from the submontane to the upper montane zone (700 - 2400 m a.s.l.). For each species encountered during the inventories we recorded the geographical distribution within and beyond Malesia to elucidate phytogeographical relationships.

Numerous new occurrence records for (Central) Sulawesi and undescribed species encountered by our study show that the island remains poorly explored. Species diversity generally decreases with elevation but varies within elevational belts, possibly owing to soil properties. Endemic species are relatively rare in submontane forests, but can contribute up to 30% of the tree flora in the montane belts.

Elevational belts in Lore Lindu National Park have distinct species assemblages, with the upper montane zone most clearly differentiated on account of its dominance by tropical conifers (mainly Podocarpaceae). Members of the families Fagaceae and to a lesser extent Myrtaceae and Lauraceae are important components of the forests along the whole transect.

Phytogeographical affinities of the tree communities change notably along the elevational gradient: Higher elevation sites have less widespread and more Wallacean and Papuan taxa.

**Merian Award Applicant**

## GENETIC STRUCTURE OF *DYSOXYLUM MALABARICUM* AT SEVERAL GEOGRAPHIC SCALES IN WESTERN GHATS, INDIA: IMPLICATIONS FOR CONSERVATION

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*Dysoxylum malabaricum* is a religiously and economically important tree species, endemic to the Western Ghats, India, one of the world's eight most important biodiversity hotspots. *D. malabaricum* is under pressure of habitat disturbance, fragmentation and overharvesting. For the improved conservation and forest management required for this species, we examined spatial genetic structure (SGS) of *D. malabaricum* at several geographical scales to understand the process of generating SGS in detail. At large scale, covering the whole species range, maternal inherited chloroplast DNA microsatellites showed northern and southern groups clearly, with a secondary contact zone. Bi-parental inherited nuclear microsatellites revealed four genetic groups and their population demographic history was related to the last ice age by approximate Bayesian computation-based analysis. Since higher levels of inbreeding were detected in the northern populations, local studies were conducted at fine scales in four sacred forests of the northern Western Ghats, examining seedling, juvenile and adult samples. At the local scale (<50km), SGS was strong regardless of age class due to restricted gene flow among forest patches. At the fine scale (<800m), significant SGS was detected in seedling populations but not in adult ones, suggesting severe mortality in sibs. In addition, similar research examined the southern Western Ghats and comparison of the data between the two regions revealed that large *D. malabaricum* trees are still distributed in the southern region although there were no large trees (>DBH130cm) in the northern region. This difference is likely due to stronger harvesting pressure in the north facilitated by recent erosion of cultural taboos regulating extraction of natural resources from sacred forests. These results will be discussed in context of seed and pollen dispersal, disturbance and fragmentation and its implications for local biodiversity.

FRIDAY 12:00



## POTENTIAL BIODIVERSITY VALUES OF ZARANINGE FOREST RESERVE, NORTH EASTERN TANZANIA

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Sustainability of the rich biodiversity of Zaraninge Forest Reserve (ZFR) and the Saadani National Park of eastern Tanzania coastal forest is threatened by the ongoing natural resource use conflicts. A study was carried out in three villages neighbouring ZFR (1) to identify important flora and fauna biodiversity, and (2) to identify important ecosystem goods and services and their influence on the well-being of local communities adjacent the forest reserve. The resources were identified and mapped by using a participatory resource assessment in collaboration with local communities. Resources Data were analyzed using SPSS statistical software. REvealed important flora species include *Scorodoploeus fischeri*, *Tricalsia allocalyx*, *Newtonia pauciaga* and *Drypetes parvifolia*. ZFR is rich in wildlife species with *Madoqua kirkii*, *Panthera leo*, *P. pardus*, *Loxodonta africana*, *Tragelaphus sttrepsiceros*, *T. scriptus* and *Equus buchelli* being some of the important fauna species. Important ecosystem goods and services include genetic pool of some important organisms, food (honey, vegetable, edible mushrooms, firewood, charcoal and herbal medicine). The ZFR offers supporting services such bank stabilization and primary production were identified as important ecosystem services. The forest plays recreational, cultural and esthetic values. Enhanced collaborative management would enhance biodiversity. Provision of social incentives to the local community represents a strong forest management approach.

## SPECIES RICHNESS OF ORTHOPTERA IN THE UNESCO WORLD HERITAGE SITE “CAPE FLORAL REGION PROTECTED AREAS”, SOUTH AFRICA

Daniela Matenaar<sup>1</sup>, Marcus Fingerle<sup>1</sup>, Florian Seidt<sup>1</sup>, Sarah Wirtz<sup>1</sup>, Axel Hochkirch<sup>1</sup>

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The loss of biodiversity is one of the major threats to modern mankind. The preservation of biodiversity in protected areas is generally believed to be the most effective tool for sustainable conservation of biodiversity. Protected areas are particularly necessary in regions with a high biodiversity, i.e. biodiversity hotspots. One biodiversity hotspot covering a whole floristic kingdom is the Capensis in South Africa. Due to its enormous plant diversity and high rate of endemism, eight reserves situated in this Fynbos-biome were proclaimed UNESCO world heritage (Cape Floral Region Protected Areas) in 2004. However, data on species richness, biogeography, ecological processes, bionomics and evolution of most endemic taxa is still scarce, particularly for insects. Such data is inevitable for developing effective conservation strategies and management plans in order to prevent the loss of biodiversity. The distribution and species composition of Orthoptera in the Cape Floral Region Protected Areas was studied during three field trips in 2012 and 2013. In each reserve five plots representing different vegetation types were surveyed for one hour each. First results indicate that diversity strongly depends on vegetation structure and coverage. Nevertheless some species, especially species belonging to Lentulidae and Pyrgomorphidae, seem to depend on the occurrence of specific plant genera. Furthermore a strongly differing Orthoptera assemblage in the Eastern Cape (Baviaanskloof Nature Reserve) compared to the Western Cape was detected. Baviaanskloof Nature Reserve, which is famous for covering five biomes on a comparatively small area, had the highest diversity of Orthoptera. A molecular phylogeny of the lentulid genus *Betiscoides* suggests that flightless taxa may comprise a high number of cryptic, hitherto undescribed species.

FRIDAY 12:30



# SCIENTIFIC POSTER SESSION – ABSTRACTS



## POLLEN ANALYSIS AS A TOOL FOR ESTIMATING PLANT DIVERSITY DYNAMICS IN A HOTSPOT REGION - POSSIBILITIES AND LIMITS

Nele Jantz<sup>1</sup>, Corinna Brunschön<sup>1</sup>, Jürgen Homeier<sup>1</sup>, Holger Niemann<sup>1</sup>, Fernando Rodríguez<sup>1</sup>, Andrea Villota<sup>1</sup>, Hermann Behling<sup>1</sup>

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The tropical Andes are one of the most species rich and most threatened Biodiversity hotspots on our planet. Little is known about the development and long-term dynamics of this diversity. Pollen analysis is a useful tool to explore vegetation history with respect to species movements and their response to disturbances. Yet, determination of pollen grains rarely reaches the species level and different pollen production rates as well as distribution and preservation properties make species richness estimates based on pollen data a difficult task. Nevertheless, pollen data often is the only source we have to give us valuable insights in past species richness dynamics. In this study, we assess possibilities and limits of biodiversity analyses based on pollen data in the south Ecuadorian Andes. Data of present pollen rain compared to vegetation data show the relationship between plant species and pollen type richness across an altitudinal gradient from 1000 to ca. 3000 m a.s.l.. Rarefaction data and diversity indices obtained from sediment cores spanning the Holocene period show dynamics of pollen type richness over time. Results indicate that present pollen rain and vegetation data show corresponding diversity patterns across all assessed vegetation types. As pollen type richness also reflects evenness of pollen as well as plant distribution and cannot be shown up to the species level, several scenarios are possible to explain past changes in pollen type richness. Nonetheless, the data show interesting developments of palynological richness patterns which can be related to climate change as well as to the rise of human impact during the course of the last ca. 10,000 years before present.



## PERFORMANCE OF *POUTERIA TORTA* (SAPOTACEAE) SEEDLINGS AFTER MODERATE ADDITION OF N AND P IN A PREMONTANE TROPICAL FOREST IN SOUTHERN ECUADOR

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The Nutrient Manipulation Experiment (NUMEX) is carried out in Southern Ecuador to investigate effects of moderate nutrient addition in different tropical montane forest ecosystems. It started in January 2008 adding moderate amounts of N (50kg ha<sup>-1</sup> yr<sup>-1</sup>), P (10kg ha<sup>-1</sup> yr<sup>-1</sup>), and N combined with P to representative stands.

Since seedling communities are thought to be more responsive to differences in nutrient availability, we evaluated the performance of tree seedlings in a pre montane forest in southern Ecuador to quantify different effects of nitrogen and phosphorus availability in this forest.

We selected the locally most abundant tree species, *Pouteria torta* (Sapotaceae), and produced 320 seedlings from seeds collected at the study site. Eighty seedlings were planted to each of the four treatments (control, +N, +P, +NP). After one year, all seedlings were measured (height, diameter, leaf number) and harvested, separated in parts (leaves, stems and roots) and dried. In addition to mass, foliar nutrient contents, specific leaf area and foliar area loss were quantified.

Seedling mortality was highest in N (69%) and NP (65%) treatments during the study year. Results revealed no differences among treatments in mean leaf area, although leaf area loss showed highest percentages in P (8.8%) and NP (10%).

**Merian Award Applicant**

## ACTIVITY PATTERN AND FORAGING BEHAVIOR OF THE TENT-MAKING BAT (*URODERMA BILOBATUM*) IN PANAMA

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We investigated foraging behavior and activity patterns of Peter's tent-making bat (*Uroderma bilobatum*) using radio telemetry in a tropical lowland forest in Panama. Three adult males, roosting under modified pinnate leaflets of American oil palm trees (*Elaeis oleifera*) at the shorelines of Lake Gatún, were equipped with radio transmitters and tracked for four consecutive nights between July and September 2013. These fruit-eating bats are fig specialists, foraging in the canopy where they pick figs in flight and carry them to a feeding site. Fruiting fig trees of various species (*Ficus insipida*, *F. obtusifolia*, *F. dugandii*), all of them known to be part of *U. bilobatum*'s diet, were identified within the foraging range of the tracked animals. We recorded flight and resting phases, as well as flight distance. Activity patterns monitored throughout the nights were dominated by extensive resting phases, interspersed by flying bouts to fruiting trees. Two reproductive males mainly concentrated their foraging activity to fruiting trees near their day roost. This behavior is also known from other frugivorous bats such as *Artibeus watsoni*, *Carollia perspicillata* or *Artibeus jamaicensis*, where reproductive males form harems of females in their day roosts, which they defend against competing males. Another individual found roosting on a small island, traversed frequently open water patches to get to fruiting trees and even set off quite far into the mainland. We conclude that spatial distribution of food sources is a strong factor shaping foraging strategies for male *U. bilobatum*, but also roost site defense may influence their range use pattern during the night.

**Merian Award Applicant**



## TREE GROWTH RESPONSES TO N AND P FERTILIZATION IN ECUADORIAN MONTANE FORESTS

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During the last decades tropical ecosystems are facing increasing atmospheric inputs of nutrients. Anthropogenic activities are raising nitrogen (N) and phosphorus (P) depositions in these areas and the consequences in the structure and functioning of these ecosystems are still barely known. The effects of continued nutrient addition on aboveground productivity is investigated in three Andean forest types within the ongoing Ecuadorian NUTrient Manipulation EXperiment (NUMEX), that started in January 2008 (adding moderate amounts of N ( $50\text{kg ha}^{-1} \text{yr}^{-1}$ ), P ( $10\text{kg ha}^{-1} \text{yr}^{-1}$ ), and N and P to representative stands). Diameters and heights of all trees in the plots  $\geq 10\text{cm dbh}$  have been repeatedly recorded during five years, as well as recruitment and mortality. Growth rates were calculated and allometric equations were used to estimate biomass and its increment. N is limiting tree growth at 3000m, while co-limitation of N and P is found at 2000m. There is a strong variance in the response to the treatments among species at the same site. After 5 years of nutrient addition, cumulative stem diameter increments were around 45% increased by combined N and P addition at 2000m and at 3000 m, and around 30% at 1000 m. Effects of separate N or P addition were much smaller. Tree biomass increment showed the same effects, which were significant only at 2000 m (+NP: 37 more biomass increment) and at 3000 m (+N: 33% and +NP: 43%).

**Merian Award Applicant**

## UNRAVELING RESPONSES OF AFRICAN SPECIES TO CLIMATE VARIABILITY AND POTENTIAL AS CLIMATE PROXIES

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In vast areas of Africa, knowledge on the range of natural climate variability and the range of tree species tolerance to climatic extremes is scarce. We have used stable carbon and oxygen isotopes in tree rings to explore their potential as climate proxies and as a means to assess their adaptations to climate variability. Most of the study sites and species in East and West Africa showed vulnerability and substantial growth reduction during drought years. Stable carbon ( $\delta^{13}\text{C}$ ) and oxygen ( $\delta^{18}\text{O}$ ) mean values showed similar inter annual patterns. In general, both  $\delta^{13}\text{C}$  and  $\delta^{18}\text{O}$  show negative correlations with rainfall, humidity and PDSI. On the contrary, they are positively correlated with sunshine hours, maximum temperature and evaporation. The results showed valuable information with regard to the adaptation and vulnerability of African species to climate variability in different agro-ecological zones and the potential of stable isotopes as climate proxy.



## ARE CARBON TRAITS CORRELATED TO REPRODUCTIVE TRAITS IN TROPICAL TREES? A CASE STUDY FROM THE DIPTEROCARPACEAE

James Smith<sup>1</sup>, Chris Kettle<sup>1</sup>, David Burslem<sup>2</sup>, Colin Maycock<sup>4</sup>, Robi Bagchi<sup>1</sup>, Eyen Khoo<sup>3</sup>, Jaboury Ghazoul<sup>1</sup>

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In view of the widespread loss and degradation of Southeast Asian tropical forests there is much interest in ecological processes that facilitate forest recovery and regeneration. Of central interest is the seed production and dispersal of trees belonging to the Dipterocarpaceae family, which may constitute over 40% of lowland forest biomass and hence are the major carbon sequesters in these habitats. Dipterocarps mostly have winged fruits that gyrate to the ground following irregular inter-annual masting events. The results of a fruit release experiment in our group show that seed dispersal kernels can be predicted based on fruit morphology and wind speed, with fruit with higher ratios of wing area to fruit weight dispersing greater distances. Such variation has implications for dispersal to, and colonisation of degraded forest microsites with further implications for forest compositional trajectories. If those species with the poorest seed dispersal store the greatest amount of carbon then potentially these forest may lose carbon over time. We posit the questions: do seed dispersal traits correlate with carbon storage traits in the Dipterocarpaceae? If yes, what do we expect to happen to carbon storage in these forests? If not, what additional data do we need to address these questions? These questions are of direct relevance to establishing new policies for international carbon emissions such as through REDD+ and multiple-use forest management in Southeast Asia. Integration of reproductive traits and their linkages to carbon might catalyse improved management practices including selective logging based on a species ability to regenerate and prioritising restoration and enrichment planting efforts on species with limited dispersal.

## BIOASSAYS SUGGEST THAT INDUCEABILITY OF DIRECT DEFENCE STRATEGIES AGAINST HERBIVORES IS AN ABUNDANT PHENOMENON IN TROPICAL PLANT SPECIES

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The Arms race between plants and their herbivores is an important driver of biodiversity. Expected variations in the tropical temperature and rainfall regime due to climate change might impact plants ability to respond to herbivore pressure in the forest. Only by learning to understand those biotic interactions there is a chance to estimate the effect of climate change.

Variability in herbivore might be affected by climate change and species disposing induced defense strategies can acclimate to their defense response to environmental conditions. Climate change impacts ecosystems faster than many long lived species can adapt. Therefore, if induced defense is an abundant phenomenon in tropical forests, this phenomenon should be considered more frequently in climate change research.

In order to estimate the frequency of induced defense strategies in a tropical ecosystem we tested the abundance of induce ability in greenhouse and field experiments in Panama and Germany. We conducted a comparative study to estimate the abundance of inducible defenses among tropical plant species differing in phylogeny and life history. A total of 85 species was tested in greenhouse experiments and 28 partly overlapping species in the field.

Up to 22 individuals per species were exposed to the inducing agent methyl jasmonate in lanolin for four days. Harvested leaves were presented to larvae of the generalist herbivore *Spodoptera frugiperda*. The standardized bioassay consisted of a dual choice experiment of leaf discs of plants with pure lanolin treatment as control and lanolin + methyl jasmonate treatment.

In non-replicated choice tests herbivores preferred leaf discs without methyl jasmonate treatment. In 49.18% of the choice tests herbivores ate at least twice as much of the control leafs compared to treated ones. In order to determine individual species that are inducible, 13 species were subjected to replicate tests. Almost one third of the species showed inducible defenses, simulated by methyl jasmonate treatment. In natural conditions we analyzed 28 species in the field. It was possible to induce 11% of the species that grew in potential herbivore presence.

Our results suggest that induced defense is a strategy that is employed by many tropical plant species in order to face variability in herbivore presence. The abundance of induced defense in leaf defenses could play an important role in the response of tropical forest to climate change. Future research focusing on climate change in tropical forest ecosystems should take this phenomenon into account.

**Merian Award Applicant**



## TAKE ME TO THE RIVER - SEED DISPERSAL IN AMAZONIAN FLOODPLAINS

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Amazonian floodplain forests are highly diverse, with more than one thousand tree species which are highly adapted to the regular flood pulse. In the present study, we summarize the available knowledge on the dispersal modes of tree species from the floodplain forests of the Central Amazon. The dispersal syndromes of the single species were determined by an extensive literature review, added by personal observations and the analysis of the morphology of the diaspores. Among the studied species, we found that all known means of dispersal common to trees are also represented in Amazonian floodplains. However, most trees display adaptations to take advantage of the seasonal flood pulse for dispersal. A high number of species are dispersed by floatation or water currents. In fact, the peak of fruit maturity occurs during the high-water period. The diaspores possess adaptations which enhance dispersal linked to water and which are not found in species of the surrounding uplands, e.g. spongy tissues, and air filled spaces. Fruits and seeds are the object of dispersal, covering all sizes and types, e.g. pods, capsules, drupes, berries, pyxidia. Besides hydrochory, zoochory is a frequent dispersal syndrome, with a high number of species being dispersed by fish. In light of the fine-tuned relationships between plants and animals, and the imminent threats imposed by human actions to floodplain forests of the Amazon River such as the building of dams, the need to understand the interactions and main modes of dispersal is fundamental for the conservation of the integrity of these forests and the food chains therein.



## HIGH GENE FLOW IN TWO THRIPS - POLLINATED SOUTHEAST ASIAN PIONEER TREES

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Fast-growing, dioecious pioneer trees of the genus *Macaranga* (Euphorbiaceae) are common elements in the lowlands of Southeast Asia, with an often dominant role in early succession. When the destruction of Bornean rainforests began a few decades ago, the increasing availability of logged patches fostered an initial rise in the local abundance of *Macaranga* pioneer trees. However, with the increasing conversion of forests into large areas of oil palm plantations, suitable habitats have become more and more fragmented, with potentially negative consequences on gene flow and genetic diversity. A better knowledge of the processes that affect the partitioning of genetic diversity in *Macaranga* pioneer trees seems therefore crucial to predict future changes in these ecologically important species. Many *Macaranga* species are pollinated by thrips and seeds are mainly bird-dispersed. Thrips pollination in the tropics has been documented in a number of plant families but it did not seem to be of general importance. As thrips are assumed to be weak flyers, their effectiveness as pollinators remains controversial.

We used nuclear and chloroplast DNA markers to address questions of genetic diversity and population structure in *M. beccariana* and *M. hypoleuca*, two closely related obligate ant-plants. Overall genetic diversity in both species was moderate to high, with low levels of population differentiation, consistent with other tropical pioneer trees. Genetic structure was generally more pronounced in plastid than in nuclear data, indicating that gene flow via pollen may be more efficient than via seeds. Thus thrips apparently serve as efficient pollinators also over long distances, perhaps through a combination of passive dispersal by wind, and active search for inflorescences in the target area. Our results indicate that *M. beccariana* and *M. hypoleuca* populations from recently disturbed habitats do not yet suffer from reduced genetic diversity or higher inbreeding. However, the genetic effects of forest deterioration may not yet be visible as most disturbances in the study sites have taken place only in the last 20-30 years. In order to assess how fragmentation of the forests affects the now isolated *Macaranga* populations in the long run, repeated monitoring of their genetic diversity is needed.



## LATE HOLOCENE ENVIRONMENTAL CHANGE AND HUMAN IMPACT IN SOUTH KALIMANTAN AND NORTH - EAST JAVA (INDONESIA), INFERRED FROM MARINE SEDIMENT RECORDS

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Pollen and organic walled dinoflagellate cysts are excellent tools to reconstruction past environmental change both on the continent and in the marine realm. Especially in archives of the coastal marine regions they are especially well suited to establish land-sea correlations.

Here we applied this tool to obtain insight into the relationship between human activity and changes in the vegetation composition of south Kalimantan and north-east Java, as well as changes in the coastal marine environments of these regions. Hereby we especially focus on the last 3000 years. For this we analysed the palynomorph content of two marine sediment cores retrieved from the Java Sea, off Jelai River (southern coast of Kalimantan) and off Bentawan Solo River (north-eastern coast of Java).

About 800 years ago in Java and about 400 years ago on Kalimantan, we find evidences for extensive logging marked by a decrease in pollen of e.g. *Dipterocarpus*, *Agathis*, *Dacrycarpus*, *Phyllocladus*). We can reconstruct an opening of the canopy and a development of the secondary vegetation based on increasing of pioneer taxa. Signals of eutrophication in the marine environment are reflected by the dinocyst associations at the same time. For last 400 years, changes in the pollen associations provide clear evidence for agricultural activity in both regions. Additionally, establishment of palm plantations and reforestation with exotic plants was indicated for the last hundred years in north-east Java.

**Merian Award Applicant**

## LONG - TERM MONITORING OF DEMOGRAPHY AND GROWTH DYNAMICS OF THREE PALM SPECIES IN A COSTA RICAN PREMONTANE RAINFOREST

Sophie Stattegger<sup>1</sup>, Jürgen Homeier<sup>1</sup>

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The populations of the three arborescent palm species *Chryosophila warcsewiczii*, *Euterpe precatoria* and *Iriartea deltoidea* have been monitored in a permanent plot (1 ha) for now more than 20 years. This unique study gives insight into the strong temporal variation of mortality, recruitment and growth processes of these species under undisturbed natural conditions in the Reserva Biológica Alberto Manuel Brenes.

**Merian Award Applicant**



## TRENDS IN DIVERSITY AND ABUNDANCE OF FEEDING GUILDS IN BIRDS ALONG A COMPLETE ALTITUDINAL RAINFOREST GRADIENT IN PAPUA NEW GUINEA

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Altitudinal gradients continue to provide an attractive setting for biodiversity studies and serve as a heuristic tool and natural experiment in the study of community ecology. Here we present robust quantitative data on bird communities along a complete undisturbed rainforest altitudinal gradient, using constant sampling effort at all altitudes.

We examined patterns of species richness, density and range size distribution of birds. We also assessed biotic and abiotic factors (tree diversity, basal area, tree and shrub density, temperature, humidity, geometric constraints and area available) that are expected to affect bird populations. The gradients located on the slopes of Mt Wilhelm in the Central Cordillera, spanning from the lowland floodplains of the Ramu river (200 m a.s.l.) to the tree line (3700 m a.s.l.). We collected bird community data at eight sites (500 m altitudinal increment) during three independent surveys (2010-2012). At each site we used point counts, mist-netting and random walks throughout the area of 80 ha to sample birds and quadrates for estimates of vegetation. We divided all recorded birds (33,641 individuals comprising 241 species) into three feeding guilds.

Data indicate that species richness and abundance decrease with altitude. However, the patterns observed in insectivores differ from patterns in other guilds. We found no evidence that geometric constraints influence observed patterns, whereas contemporary climate accounted for the most of the variation in observed patterns, except those observed in insectivorous birds. Tree diversity, density and basal area were important explanatory variables for insectivorous birds. We recorded the highest rate of change in community composition between 1200 and 1700 m for all feeding guilds, and another abrupt change in composition between 2700 and 3200 m for insectivores only. Observed community turnovers did not correspond with ecotones.

## THE ABUNDANCE OF RARE TREE SPECIES IN REMNANT FORESTS ACROSS THE VISAYAS, PHILIPPINES

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In several tropical regions of the world, formerly widespread forests have been reduced to scattered remnants. Here, reforestation based on native species and mixed stands is an important option for land use and nature conservation. A problem is that many native tree species are becoming rarer and their occurrence is often unknown, which makes it difficult to find for planting materials. Also, species-site associations are often not well understood. We studied 20 mostly red-listed native species in remnant forests on limestone and volcanic sites across the Visayas, Philippines. In each of the 10 study sites, 40 plots were assessed. Seventeen of the species had a median density of less than two trees per ha where 10 of these species had median densities of zero due to low species frequency, although some had higher densities in the specific sites where they occurred. One species (*Dracontomelon edule*) was not encountered at all while two other species (*Dipterocarpus validus* and *Dracontomelon dao*) were only encountered as singletons. Six species were confined to limestone sites and showed association to other better-known limestone specialists. The other study species occurred at both site types. Four of the studied species showed significant relationships in stem densities with soil pH and stand basal area. With respect to management, effective protection of remnant forests is strongly suggested; the collection of planting materials may be permitted in the meantime up until stands of mixed native tree species in accordance with observed associations among species and sites are established.



## THE IMPORTANCE OF PRODUCTION AND DISPERSAL OF PROPAGULES FOR MANGROVE REGENERATION IN A TROPICAL COASTAL LAGOON SYSTEM

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Originally, an area of 511.5 km<sup>2</sup> of the lagoon system of the Ciénaga Grande de Santa Marta (Colombia) was covered by mangrove forests. About half of these forests died between 1975 and 1995 due to human interventions in the hydrological conditions. At the beginning of the 1990's plans were elaborated which should allow mangrove regeneration. The most important measure was the reconstruction of channels which connected the Magdalena River with the lagoon system. Mangrove species present in the lagoon system are *Avicennia germinans* (L.)L., *Laguncularia racemosa* (L.) C.F. Gaertn. and *Rhizophora mangle* L.. At the time when restoration measures began, only few mangrove stands showing the original species composition and zonation survived in the eastern and southern part of the lagoon system. In the western part, mangroves were fragmentary. Moreover, *R. mangle* was missing in large areas of this part. Therefore, it was uncertain whether the production and dispersal of mangrove propagules would be sufficient to allow mangrove regeneration in all sites. Studies of the dispersal showed that most propagules remained near the mother tree or were washed ashore within a distance of 200 m, at the most. Only propagules falling into channels with currents could be transported up to 2.5 km. On the other hand, floating aquatic meadows and *Typha* beds retained the propagules. In general, due to the nature of dispersal, the regeneration of destroyed forests began at the edges of water bodies or surviving mangrove stands and proceeded step by step colonizing the bare areas. In the western part, regeneration was delayed by a temporary colonization of former mangrove areas by *Typha domingensis* Pers. Moreover, the re-colonization of areas of suitable water level for the growth of *R. mangle* started slowly due to the insufficient supply of propagules.

## TEN YEARS OF CZECH ECOLOGICAL RESEARCH IN CAMEROON

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At the beginning of millennium (in 2001-2003) we were lucky to start an ecological research in Republic of Cameroon. Since then it has developed and directions of our investigations crystallized. Recently, we focus our efforts mostly on understanding processes behind spatial changes of biodiversity in terms of species richness as well as diversity of ecological functions. We work mostly with birds, plants and insects (especially butterflies) and concentrate ourselves on various topics of evolutionary ecology and biogeography from description of geographical distribution of particular species to analyzing structures of local assemblages and searching for factors responsible for the observed differences. In addition, we are interested in the role of ecological adaptations in biodiversity maintenance. Our research includes issues related to ecological space use, life history evolution and relationships among organisms such as plant-pollinator interactions. We have been working mostly in fragmented landscapes of the Bamenda Highlands and along elevational gradient of Mt. Cameroon. Outputs of our studies relate also to conservational issues such as forest fragmentation or identification of habitat requirements in endangered species. Here, we would like to briefly present main directions of our current research efforts in Cameroon.



## TOWARDS UNDERSTANDING AND MANAGING SPATIAL DYNAMICS OF TROPICAL BRACKEN (*PTERIDIUM CAUDATUM*) IN THE “SIERRA DEL LACANDÓN” IN GUATEMALA

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The National Park “Sierra del Lacandón” (NPSL) in northern Guatemala is a megadiverse rainforest ecosystem and provides habitat and refuge for a vast diversity of flora and fauna.

Despite its conservation status, the NPSL is constantly threatened by the high deforestation rate particularly due to forest clearance by fire. In this context southern bracken (*Pteridium caudatum*) comes into focus, a tropical weed that plays a crucial role in tropical fire ecology. Bracken easily establishes on burnt soils after fire events, limits the viability of co-existing plant communities and therefore impedes agricultural land use and afforestation activities. Repeated burning of bracken-infested areas increases bracken abundance and additionally, local stakeholders describe bracken as a driver itself for enhancing combustibility and uncontrolled forest fires.

For an adaptive management we need to identify indicators to monitor dynamics and evaluate conservation practices. In the present study we examine changes in the spatial characteristics of bracken stands using remote sensing and geographic information science. With both image and field-based data we test the hypothesis that bracken increases area combustibility and favors the spread of uncontrolled forest fires. Building on that, we compose scenarios of a locally adapted bracken management, also considering the link between environmental and social aspects.

We assume that an adaptive bracken management might finally diminish area combustibility and lower the pressure on intact forest areas in the NPSL.



## GEOTECHNOLOGY AND LANDSCAPE ECOLOGY FOR MONITORING FOREST FRAGMENTATION

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Several indicators contribute to a better understanding of the patterns and behavior of the landscape over time. Thus, the aim of this work was to obtain a diagnosis and a multitemporal analysis of structural connectivity of fragmented landscape surrounding the Reserva Particular do Patrimônio Nacional de Cafundó, Espírito Santo - Brazil, with the help of geotechnology. We used aerial photographs from 1970 and 2007 to map the land use cover, detection cover changes and analysis landscape metrics. A quantitative description of landscape structure, using metrics of landscape ecology, was performed with the GeoDMA plugin, based in thematic maps of land cover. The analyzes showed that the evolution of environmental degradation can be checked with the increase in the number of polygons of 704 to 1264, as well as the area of some classes, such as bare soil, which rose from 0.5 Km<sup>2</sup> to 3.1 km<sup>2</sup> between the years analyzed. The average distance of polygons in relation to the Conservation Unit increased from 2.06 km to 2.12 km, demonstrating a breakthrough toward the ends of the area. The forest remnants smaller than 1 ha accounted for about 49% of the polygons of this class in 1970 and about 65% in 2007, i.e., an increase of fragmentation reducing the area of the polygons. The degradation of the area was also confirmed with the metrics Perimeter/Area and Shape index so indicated more irregular polygons, except for pasture and agriculture. A regular polygon class may be associated with agricultural plantations which are usually made in the form of regular stands for facilitating the mechanization and the class represented by this pasture matrix, about 60% of the total area. Forest cover accounted for only 20% of the total area. Thus, over the 37 years was observed by means of landscape ecology, a major transformation of the study area, which confirms the need to implement policies aimed at restoring and the relevance of these studies to analyze the conditions of the landscape.



## MODELING THE IMPACTS OF CLIMATE VARIABILITY AND LOGGING ON THE DYNAMICS OF A DRY TROPICAL MONTANE FOREST (MUNESSA FOREST, ETHIOPIA)

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Dry tropical montane forests have received less scientific attention compared to tropical lowland forests, although they are as highly endangered due to the expansion of agriculture, commercial logging or climate change. The tropical montane forest of Munessa-Shashamene in the south-eastern part of Ethiopia is a prominent example of deforestation and degradation in the sub-humid tropics. The natural high forest cover of Ethiopia decreased to only 3 % in the vicinity of the study area. Local climate is characterized by a dry season from November to March, a rainy season from July to October, and an unreliably short rainy season during April to June. During the recent years an increasing amount of precipitation events during the short rainy season has been observed. To counteract replacement of remaining natural forest patches by introduced exotic tree species, more scientific information on the ecological behavior of native tree species is needed. Dynamic simulation models can be used to analyse forest growth, but so far they have been used applied to temperate forests and lowland rainforests.

In this study we investigated if the process-based, individual-oriented simulation model FORMIX 3-Q is able to reproduce the dynamics of the tropical montane forest in Ethiopia. We parameterized the model and validated against field observation data. Then the predicted succession dynamics were analysed. Tree growth is calculated on a carbon and biomass balance. The model is able to reproduce the structure and dynamics of the mature forest on several levels of complexity. The main results indicate that the model predicts the observed stand structure for the total biomass, stem numbers and competition. We were able to synchronize the growth patterns of 20 growth curves measured on five stem discs of the deciduous broad-leaved pioneer tree species *Croton macrostachyus* and to establish a 35-year ring-width chronology. This first available tree ring chronology of *C. macrostachyus* was used as one part of the parameterization to validate the diameter increment for the species.

The model has a variety of potential applications, ranging from investigating the impact of precipitation variability on forest structure and tree species diversity. It is thus a useful tool to extrapolate of local growth measurements, to simulate forest dynamics and to analyze the impact of different management strategies on dry tropical montane forests in Ethiopia.

**Merian Award Applicant**

## USING 10 YEARS' SURVEY DATA TO ASSESS ENVIRONMENTAL VARIABLES ASSOCIATED WITH THE DISTRIBUTION OF SUMATRA RHINO IN SABAH, MALAYSIA

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Effective conservation of endangered species needs a thorough understanding of their basic requirements. The Sabah rhino (*Dicerorhinus sumatrensis harrissonii*) is a critically endangered subspecies of the Sumatra rhino. Less than 20 individuals are estimated to exist in the wild. The largest proportion of this subspecies occurs in the northern tip of Borneo, in the East Malaysian state Sabah. A few individuals have recently been discovered in the Indonesian part of Borneo, in East Kalimantan but numbers are expected to be low.

The Sabah rhino occurs in lowland rainforests, which are characterised by a high diversity in flora and fauna. The majority of these forests have been selectively logged in the past and converted into oil palm plantations. The remaining pockets of lowland rainforests are surrounded by oil palm plantations, preventing any reproductive contact between populations. Currently two separate rhino populations exist in Sabah, one living in the Tabin Wildlife Reserve and the other in the Danum Valley Conservation Area. Virtually no information is available about the number of these rhinos, their sex, age, movement patterns, habitat requirements or reproductive behavior. This lack of information about basic population and life history parameters is largely owing to the inaccessible rainforest habitat and the rhinos' secretive lifestyle. However, without knowledge about these important factors, efforts to save the Sabah rhino from extinction will be misdirected or too vague and have little chance of success.

In the study we analyze data collected by field rangers during their monthly surveys in the Tabin Wildlife Reserve between 2001 and 2010. The presence of rhinos was indirectly measured by recording GPS positions of footprints, feces and feeding signs. Environmental variables were calculated from satellite data, such as distance to streams, roads, human presence as well as vegetation type. These variables were selected according to their potential biological relevance for the Sabah rhino. We used a use v. availability model in order to understand the factors that determine the spatial distribution of rhinos necessary in order to take sound and specifically targeted management decisions, such as the translocation of isolated individuals and the establishment of forest corridors connecting isolated rhino populations.



## EVALUATING ECOLOGICAL AND CULTURAL SERVICES PROVIDED BY TROPICAL FOREST ECOSYSTEMS: A CASE STUDY IN INDONESIAN BORNEO

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With ever-increasing human populations and continued land use conversion, the Indonesian province of Central Kalimantan has seen rapid and sustained deforestation and forest degradation. These forests are vital for the provisioning, regulating and cultural ecosystem services they provide. This includes their role as a carbon sink, the preservation of which is globally important for greenhouse gas emissions reductions. The need for an ecosystem approach to conservation is being increasingly recognised by the international conservation community. Assessing, valuing and monitoring ecosystem services, in conjunction with local communities, are vital components of this approach, yet the valuation and assessment of forest ecosystem services are complex and much-debated. This PhD aims to identify the problems and, where possible, solutions to these issues in Central Kalimantan. This includes increasing understanding of the environmental and landscape functions of these forests, such as flood mitigation, biodiversity maintenance and cultural values. This will include investigation of the diverse, contested and dynamic values placed on forests by local communities, their motivations and associated practices with respect to forest management. Accordingly, this project will be important in developing a more ecosystem-based, interdisciplinary approach to conservation, thereby promoting sustainable management of natural resources for the protection of the suite of benefits provided by the forests of Central Kalimantan. This will ultimately both support efforts to i) safeguard forests, significant to the international community in the context of the UN REDD+ programme, and ii) enhance livelihoods, in the context of Rio +20 and international commitments to new Sustainable Development Goals. With it being the first year of the project, the presented poster will provide an overview of the issues to be addressed and the main methodological approaches that will be used.

## PROTECTING THE KENYAN ENDEMIC BIRD SPECIES HINDES BABBLER WHILE IMPROVING WATER SECURITY

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A buffer zone along rivers in xeric shrubland in East Africa could counter biodiversity loss while improving water security and might therefore represent a successful example for land sharing. As indicator species in this study we used the Kenyan endemic Hindes Babbler *Turdoides hindei*, which is only found in thickets along riverbanks. It is sensitive to habitat change as a result of for example increasing agricultural use and to consequences of climate change. Illegal brick and charcoal production as well as deforestation including prevalent shrub burning add further stress factors.

Based on recordings of habitat structure, GPS data and GIS mapping, the moving and foraging behavior of this vulnerable bird species was examined. Analyses show that the territories with the highest probability of presence are fragmented and bounded by open fields. Due to a lack of natural habitats the birds' occurrence is almost entirely restricted to introduce *Lantana camara* shrubs. To avoid further negative consequences for the bird population simple conservation measures are suggested. These include the preservation of corridors and groves and the maintenance of a buffer zone along the river. This might at the same time enhance food security for the human population by preventing the river from draining - a priority concern in a region with increasing population pressure.

The awareness as well as the willingness to adopt conservation measures was examined using a questionnaire in English and Kiswahili. Among people living and cultivating near Nzeuu River, the survey indicates a general insight into environmental coherences and predominantly, the will to take action.

### Merian Award Applicant



## UNDER A CHANGING CLIMATE: LIVELIHOOD STRATEGIES IN RURAL FOREST DEPENDENT COMMUNITIES. A SOCIO-ECONOMIC ANALYSIS FROM TROPICAL BOLIVIA

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Deforestation, agriculture, drought and irregular rainfall interact with climate change in lowland Bolivia. The two study areas that include indigenous communities located in the Chiquitania, department of Santa Cruz in Eastern Bolivia and in the TCO Takana, in the North Bolivian Amazon show evidences of raising concern about its effect on the livelihoods of rural people.

The effect of climatic extreme events on the use and role of forests and forest products in the livelihoods of the rural people is hardly understood so far. This ongoing PhD study is part of the International Network on Climate Change (INCA) at TU Dresden, Germany, and investigates forest dependency and the impact of changing weather conditions on livelihood activities, as well as possible adaptation strategies. The following research questions are center of interest: Which livelihood activities are affected by changing weather conditions and how? What is the role of forest and forest products in climate change adaptation and coping strategies? Do farmers shift from climate affected income activities to a more intense forest use? Using a case study approach, the socio-ecological system has been investigated in a holistic way: participative tools such as field laboratories and about 70 household surveys have been conducted to gain highly required quantitative data, a photo-elicitation method (planned for 2014) will show rural people's perspective.

Preliminary findings show that the changing environmental frame conditions affect among others agricultural calendars, crop yields, timber harvest and tend to change land-use systems. Significant negative effects on the ecosystem and its provisioning of goods and services can pose substantial risks to the safety net of the rural poor in climatic extreme years. The Chiquitanian community suffered yield losses, changed crop types in recent years and invests now more in cattle ranching projects, going for a more stable income. Amazonian families were partly unable to prepare their shifting cultivation fields due to unusual and heavy rainfall. Generally, there is a trend visible towards more timber harvest and less agriculture.

The results are expected to raise understanding on interaction of livelihood types, forest dependency and climate change and may additionally contribute to the development of future scenarios.

## TREE ISLANDS IN A SEA OF OIL PALMS - A MEASURE OF BIODIVERSITY CONSERVATION

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Transformation of rainforest into large-scale mono-cultural oil palm plantations has led to dramatic losses in biodiversity and ecological functions. Re-establishing diverse habitats by restoring ecological multi-functionality in oil palm landscapes has been proposed, but the hampering or facilitating ecological and economical processes are largely unknown.

We report on the recent establishment of an enrichment planting experiment in gaps within a mono-cultural large-scale oil-palm plantation in the province of Jambi, Sumatra, Indonesia. This combined biodiversity ecosystem functioning and enrichment planting experiment addresses two main questions: 1) Can biodiversity and associated ecosystem services be restored by enrichment planting? 2) Under which planting strategies do enhanced ecosystem services positively affect oil palm economics?

We planted 48 tree islands of systematically varying size (5x5 m, 10x10 m, 20x20 m, 40x40 m) with a total of 6354 individual trees belonging to six multi-purpose species native to Sumatra, following a random partitions design with four partitions series (tree diversity levels of six, three, two and one) plus four treatments without planting subject to natural succession, resulting in a total of 52 plots. The monitoring of ecological processes currently focuses on 1) seed traps to study seed rain, 2) annual individual-based surveys of the understory vegetation surveys within 2x2m subplots in each of the 52 plots to investigate the successional trajectory, 3) growth rates and survival of the planted trees and 4) harvest data of oil palm within and next to the plot are documented.

Combining the botanical with zoological monitoring data (arthropods and birds), the results of the enrichment planting experiment will allow us to evaluate the effectiveness of proposed designer plantation landscapes, and may contribute to the development of ecologically improved and socio-economically viable management concepts in oil palm landscapes.



## FLORISTIC DIVERSITY AND REPRODUCTIVE PATTERNS ALONG AN ALTITUDINAL GRADIENT IN BRAZIL

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The correlation between plant species distribution and richness and altitudinal variation is well known for the tropics. However, much less is known about the reproductive patterns of plant communities along such gradients. Considering the wide variation in the species composition and richness and reproductive patterns at high altitudes, our main goals is to investigate: (i) what are the patterns of vegetation changes associated with the altitudinal variation (800 - 1400 m a.s.l.) in rupestrian fields? (ii) Is there a diversity of reproductive patterns associated with the altitudinal variation? We performed this study in area of Serra do Cipó located in the Espinhaço mountain chain, Southeast Brazil. To this end, we collected plants and observed reproductive phenological monthly, in six different altitudes along the Serra do Cipó. In each area, we distributed 13 plots of 20 m<sup>2</sup>, where we sampled all plants with diameter at ground height (DGH)  $\geq 1$  cm. We found 242 species belonging to 48 botanical families. We observed changes in species composition and richness following the altitudinal gradient, where species at low elevations form a more woody and lush vegetation that gradually changes to herbaceous vegetation rich in species in high elevations. The flowering pattern also followed the gradient with the lowest areas presenting the flowering date about eight months later in relation to high altitudes sites. We conclude that the soil and climatic conditions along the altitudinal gradient, govern the changes in the distribution of plant species and their respective reproductive seasons in this mountainous landscape of Brazil. (Support: FAPESP-Vale, CNPq)



## WATER USE OF BAMBOOS: METHODS TEST AND FIRST RESULTS

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Bamboos (Poaceae) are widespread and play an important role in tropical and subtropical natural forests and land use; but little is known about bamboo water use rates. We used thermal dissipation probes (TDP), an inexpensive instrument widely applied to monitor sap flux in trees, along with the stem heat balance (SHB) method and gravimetric measurements (GM) of water use. Five potted *Bambusa vulgaris* culms were studied with GM, SHB and TDP. All three methods gave similar response patterns of sap flow to changes in environmental conditions. SHB and GM also gave similar water use rates (kg d<sup>-1</sup>). We conclude that SHB can be used as a reference method for calibration while TDP needs calibrations for the assessment of absolute water use quantities.

To better understand bamboo water use for (non-potted) bamboos under ambient conditions, in a second step four bamboo species (*B. vulgaris*, *Dendrocalamus asper*, *Gigantochloa atroviolacea*, *Gigantochloa apus*, 5 culms per species, 7 to 15 cm culm diameter) were monitored for three months by TDP and SHB in a common garden in Bogor, Indonesia. SHB yielded 32 to 82% higher water use than TDP. TDP was adjusted accordingly by a species specific calibration. High maximal sap flux densities ( $J_{s\ max}$  107 to 301 g m<sup>-2</sup> s<sup>-1</sup>) were observed; these exceed values of many trees and two bamboo species studied elsewhere. After taking diameters and culm wall thicknesses into account, the derived rates of water use for transpiration however, were close to those of the two other thus far studied bamboo species. We conclude that TDP can be used in bamboos after proper calibration and that sap flux in bamboos may be high.



## EL NIÑO SOUTH OSCILLATION AND ITS LINKAGES WITH CLIMATIC SYSTEM OF SOUTH AMERICA DURING MID-HOLOCENE USING CCSM RECONSTRUCTIONS

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El Niño South Oscillation (ENSO) causes extreme weather conditions in South America, and understanding its relationship with climate variables for long periods is crucial for prediction of future scenarios. In this way, this study explored the seasonal effects of ENSO on climate variables (temperature, precipitation) in South America during the Mid-Holocene (MH - 6000 BP), within this scope Orthogonal Empirical Functions was applied to simulations of CCSM (Community Climate System Model) developed by the National Center for Atmospheric Research (NCAR). Its responses were also compared with climate reconstructions based on palaeoenvironmental indicators presented in scientific articles. The simulations for the MH showed that ENSO was weaker than in present, representing 52.3% of the variance of climatic parameters in summer and 36.8% in winter while under current conditions, it is responsible for 73.4% and 53.5% for summer and winter respectively. This way, drought periods observed in northern and eastern South America for MH, were less intense than in the present as well as precipitation in southern Brazil for periods of ENSO activity. A satisfactory agreement was noticed in comparison of climate variables reconstructed with CCSM and conclusions made with palaeoenvironmental indicators, discrepancies in specific sites may be related to the model resolution. In summary, CCSM shows reliable responses to climatic conditions of South America being in accordance with other climate reconstructions studies that use GCM (Global Circulation Model) and palaeoenvironmental records, in this way it is an important tool for reconstruct climate conditions for regions with lack of palaeoenvironmental records. For areas where there were no good agreement, questions should be raised in order to associate proxies with computational models to obtain more consistent reconstructions.

## PERSISTING IN A WINDY HABITAT: POPULATION ECOLOGY AND BEHAVIORAL ADAPTATIONS OF TWO ENDEMIC GRASSHOPPER SPECIES IN THE CAPE REGION (SOUTH AFRICA)

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Global biodiversity hotspots are rich in endemic insect species, many of which are threatened by the ongoing anthropogenic pressures on their habitats. The Cape region (South Africa) is one of these biodiversity hotspots, maintaining a high number of endemics. However, the ecology of most insect species in this region remains poorly understood. The two Orthoptera species *Betiscoides meridionalis* and *Betiscoides parva* are endemic to the Cape region and specialized on restio vegetation. They are threatened by increasing wildfire frequencies and invasions of non-native plant species. However, this information has been inferred from habitat changes, whereas no ecological study on these species has been conducted since they have been described. In order to facilitate conservation management, information on the ecology of these species is urgently required. The aim of our study was (1) to obtain data on the population ecology (particularly population sizes and mobility), and (2) to study the behavior of both species in response to environmental factors. For this purpose a mark-recapture-study and an observational behavior study were conducted. Both species had small population sizes and a low mobility with males moving greater distances than females. Wind had a strong influence on the behavior of *Betiscoides*, particularly on the small males of *B. parva*. Future studies might thus focus on the question whether wind-exposure is a critical factor for habitat choice of this species. We strongly recommend enhancing the connectivity of restio habitats and restoring these habitats to prevent extinction of specialized insect species.



## PHYLODIVERSITY RESPONDS MUCH QUICKER TO CHANGES IN ELEVATION THAN TAXONOMIC DIVERSITY

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The increasing impact of land use and climate changes has lead to modifications in structure and composition of natural ecosystems across the globe. Resulting loss of biodiversity can affect important ecological functions. Consequently, it is essential to monitor functional biodiversity and important ecosystem processes. As species richness as a measure of biodiversity ignores almost 89% of the “overall diversity” and many traits of species show a phylogenetic signal, phylodiversity is often a better indicator of functional processes than species richness. We therefore analyzed how changes in elevation affect the taxonomic diversity and phylodiversity of trees of the Andean Mountain rainforest of Ecuador. Preliminary results showed no response of taxonomic diversity to changes in elevation. In contrast, phylodiversity showed a humped relationship with elevation with highest phylodiversity values at midelevational zones. Further analyses of both taxonomic diversity and phylodiversity will provide deeper insights on the potential to use phylodiversity as indicator of functional processes of tree communities.

## SMALL - SCALE SPATIAL DISTRIBUTION OF PIPERACEAE AND RUBIACEAE IN A TROPICAL MOUNTAIN ECOSYSTEM IN SOUTHERN ECUADOR

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The objective of this study was to investigate the role of small-scale topographic heterogeneity for the distribution patterns of plant species in tropical mountain ecosystems, with special emphasis on the question whether the general pattern of the elevational gradient of species richness (SR) is mirrored by topographic gradients at a local scale.

The study is based on presence/absence data of the species of two model taxa (Rubiaceae and Piperaceae) from sample plots located in a forest reserve (ca. 11 km<sup>2</sup>) in the Andes of southern Ecuador (1800 - 3200 m asl).

Both species distribution models (SDM) and macro-ecological models of SR (MEM) were set up using an ensemble modeling approach and predictor variables derived from a digital elevation model - elevation, topographic position index (TPI), slope, aspect and topographic wetness index. The ensembles comprised models of five model classes (GLM, GAM, MARS, RF and GBM) that were fitted over a large set of initial conditions created by repeated random divisions of the data into training and testing datasets (100 repetitions for each model class). Prediction accuracy was evaluated by the biserial correlation coefficient in case of SDM and the root mean squared error in case of MEM. Consensus predictions were computed as the weighted average of the predictions of the 50 best performing models (weighted by their evaluation scores).

SR of both taxa could be well predicted by the available topographic predictors. Elevation and TPI were by far the most important predictor variables for SR, with TPI explaining a similar proportion of the variability in SR as elevation. In both families, SR decreased substantially from valleys to ridges. Piperaceae SR was found to decline continuously with elevation, while Rubiaceae SR peaked at 2300 - 2500 m asl. The distributions of individual species varied considerably between species even at the small scale of the research area, reflecting their distinct ecological requirements.

**Merian Award Applicant**



## WOOD CHARACTERISTICS OF ALCHORNEA LOJAENSIS [EUPHORBIACEAE]

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*Alchornea lojaensis* Secco is an evergreen broadleaved tree species which occurs in the tropical mountain forests in Southern Ecuador at about 2000m a.s.l. [Reserva Biológica San Francisco: 2067 mm; 15,3°] Although the species has been described by Secco in the year 2008, nothing is known about the wood structure and wood anatomical parameters, yet.

We present a thorough descriptive and quantitative wood anatomical analysis of 15 different branches of *A. lojaensis*. Our preliminary results reveal that despite the constant perhumid conditions of the study area the examined tree species exhibit seasonal growth rhythms, becoming visible in distinct growth boundaries. High resolution microscopic images of *A. lojaensis* depict tangential bands of flattened and thickened libriform fibres marking the growth ring boundary.

Analyses of quantitative wood anatomical characteristics (e.g. vessel diameter, vessel area or vessel frequency) are presented. Influences of environmental factors on the wood anatomical properties are evaluated and the potential for past climate reconstructions are discussed.

### References:

Secco, R. (2008): *Alchornea lojaensis*, a new species of Euphorbiaceae for the Flora of Ecuador. In: KEW BULLETIN VOL. 63: 511 –513. DOI 10.1007/s12225-008-9043-9.

### Merian Award Applicant

## RENDEZWUE: CANOPY EVAPOTRANSPIRATION MEETS WATER USE EFFICIENCY OF LEAVES

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Evapotranspiration and water use efficiency (WUE) are useful indicators to monitor the impact of environmental changes on ecosystem functioning. For area-wide monitoring there is a need to upscale water and carbon flux measurements from leaf to the landscape. In this work we combine two techniques to assess evapotranspiration and photosynthesis in two scales: leaf and canopy. A gas porometer was used to measure transpiration and photosynthesis of green leaves and calculate water use efficiency. A dual-beam small aperture scintillometer, extended with a weather station, was used to measure evapotranspiration above the canopy. The name RendezWUE refers to the simultaneous use of these instruments (porometer and scintillometer) for measurements on green leaves (leaf level) and above canopy (canopy level). The approach was tested on a pasture area located in the valley of the San Francisco River, South Ecuador. The site is covered by the grass *Setaria sphacelata*, planted in rows, around three years old, and not intensively grazed. For the scintillometer the measurement height was 2 meters and the path length (between transmitter and receiver) was 89 meters. Measurements with the porometer were carried out along the scintillometer path. Five daily courses are available covering different weather conditions. For instance, on a sunny day, canopy evapotranspiration reached peaks of 1 mm/hour while the highest leaf transpiration was 0.4 mm/hour. The correlation coefficient between canopy evapotranspiration and leaf transpiration was higher than 0.9 and their ratio corresponds to that of the leaf area to the ground area. The RendezWUE approach allows the direct up-scaling of evapotranspiration from leaf to canopy and will be next used to calculate water use efficiency on both scales. In the future this technique will be deployed in a forest site, in which evapotranspiration and water use efficiency will be available from tower observations.

**Merian Award Applicant**



## **INTEGRATION OF REMOTE SENSING TECHNIQUES AND ECOSYSTEM SERVICES INFORMATION TO MEASURE DEGRADATION IN THE TROPICAL RAINFOREST OF ECUADOR**

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Forest degradation is a serious problem, particularly in developing countries. It affects the social, cultural, and ecological functions of forests, and it is a silent killer of sustainable development. In Ecuador, forest degradation is one of the greatest direct threats to biodiversity and forests, also affecting the forest ecosystem services. In this context, the country has a number of national-level governmental plans, and policies that support efforts to reduce forest degradation and moreover there are local initiatives being carried out by non-governmental organizations. One recent project aiming to promote sustainable forest management is located in the Napo province (Central-Northern Ecuador) which has one of the greatest concentrations of biodiversity within the world's tropical forests. In collaboration with this initiative, the goal of this study is to integrate remote sensing techniques and information on ecosystem services to measure tropical forest degradation. In this respect, the main objectives are: (1) to measure the structural aspects of forest degradation by remote sensing methods and (2) to relate structural forest degradation to the provision of ecosystem services by interviews. The study area is characterized by permanent cloud cover; therefore active remote sensors combined with field surveying are being used to measure the structural aspects of forest degradation. In order to understand how forest degradation is related to the provision of ecosystem services, interviews will be carried out with forest experts and community representatives from the Hamtun Sumaku and Rucullacta communities. Currently, RADAR images and field surveying data are being compiled. The results will be used to evaluate the potential of RADAR images to detect degradation in tropical forest, to highlight the relations between degradation and different types of forest management and to raise awareness for the perception of local communities on forest degradation. Finally, the study will give recommendations for the assessment and management of forest degradation in tropical forests.

**Merian Award Applicant**



## SPECTRAL AND STRUCTURAL PROPERTIES OF A TROPICAL MOUNTAIN FOREST BY REMOTE SENSING

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Remote sensing is an essential tool for area-wide monitoring, for the development of conservation strategies, and management of natural resources. In the biodiversity hotspot of the tropical mountain forest, remote sensing products should consider not only sensor and terrain limitations, but also the individual and area-wide levels. In this work we focused on the retrieval of structural (e.g. height, leaf area, and density profiles) and spectral (e.g. water and vegetation indices) properties of vegetation. Different retrievals are compared at two spatial scales: crown and landscape. In addition, we have developed automatic tree-crown detection and classification algorithms, which is in line with individual-based investigations. Remote sensing techniques used are: airborne laser scanning of discrete type with high granularity (>10 returns per square meter); airborne hyperspectral scanning; and multispectral satellite remote sensing at two spatial resolutions (ground sampling distance of 2.5 and 30 meters). We present remote sensing products for the valley of the San Francisco River, Southern Ecuador, and the current state of processing techniques and validation analyses. Discussion includes the application of remote sensing techniques in both individual and area-wide levels.



## DOES THE IMPORTANCE OF AGROFORESTS AND TREE PLANTATIONS FOR FOREST BIRDS IN THE MALAY ARCHIPELAGO DEPEND ON ISLAND SIZE?

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An increasing number of bird species is threatened by the ongoing loss of tropical rainforests. However, the proportion of forest species being able to survive in land-use systems such as agroforests and tree plantations remains largely unclear. The Malay Archipelago, a region characterized by an extremely high number of endemic birds, globally faces the highest rates of forest loss. Based on a comprehensive study of the available literature a data base was generated containing the following information for all forest species of the Malay Archipelago: colonized islands, habitat affiliation, feeding guild affiliation and body size. Based on this data the following questions were addressed: (1) Do forest birds occupy broader ecological niches on smaller islands, perhaps due to a competitive release caused by a lower species richness? (2) Consequently, do land-use systems such as agroforests and tree plantations have a higher importance for bird conservation on smaller islands? A preliminary analysis considering a total of 586 forest species and 18 islands demonstrates that the niche width of forest birds increases with declining island size. Forest species of smaller islands (e.g. Sangihe, Salayar, Morotai, Obi) are more frequently able to use secondary habitats as forest dependent species of larger islands (e.g. Borneo, Sumatra, Java, Sulawesi). However, further studies have to quantify to what extent the reproductive success of these forest birds differs between forest and secondary habitats. For a certain proportion of forest birds these habitats may rather represent *ecological sinks* (e.g. exclusively used by foraging birds) than suitable habitats for reproduction.

## REACTION OF BIRD COMMUNITIES TO FOREST RESTORATION IN SUMATRA

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In recent years, due to excessive logging and forest degradation, tropical forests disappear in alarming rate. Many studies focused on the impact of the devastation in tropical regions usually only compare communities between primary forest and agriculturally exploited vegetation. Those dealing with the dynamics of tropical forest recovery are still rare but in practical conservation far more usable. We have a unique opportunity to cooperate with projects dealing with the rainforest regeneration in northern Sumatra and see if the communities are able to return to its restored habitat and how the decolonization proceeds. Model group for this experiment are birds as a good indicator of environmental quality and because of their ability to respond relatively quickly to habitat changes. For this purpose we mapped the structure of bird communities in the revitalized secondary forest and two sites of primary rain forest in the Leuser ecosystem. We found that the composition of all bird communities differs. In following years, we will be able to determine whether there is an interannual change in bird communities of the secondary forest, and which groups of species in this community dominate or contrarily are missing. This knowledge will find practical application both in the preparation of forest restoring projects, as well as setting priorities in the protection of bird species.



## EFFECTS OF LOGGING, HUNTING AND FOREST FRAGMENT SIZE ON FAECAL GLUCOCORTICOID LEVELS OF TWO NEOTROPICAL PRIMATES

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Habitat loss, habitat fragmentation and other anthropogenic disturbances often have a negative impact on animal populations, and therefore are a major concern to the conservation of endangered species. Anthropogenic disturbances can inflict physiological stress (i.e. increased glucocorticoid output) on animals. Long-term elevations of stress levels can have detrimental effects on the reproduction of animals and on population viability. Here, we investigated the effect of forest fragment size, logging and hunting on glucocorticoid levels of two sympatric neotropical primate species, brown spider monkeys (*Ateles hybridus*) and red howler monkeys (*Alouatta seniculus*), two species that have been reported to contrast strongly in their ability to cope with anthropogenic disturbances. We collected faecal samples from eight groups of wild spider monkeys (from seven different fragments) and 31 groups of wild howler monkeys (from ten different fragments) in Colombia. We measured faecal glucocorticoid metabolite (FGCM) levels in both species while controlling for several potentially confounding factors (group size, time of sample collection, sex, age and female reproductive state). Fragment size did not influence FGCM levels of either species. Spider monkeys showed elevated FGCMs in fragments where logging and hunting occurred, whereas we did not find this effect in howler monkeys. This suggests that the two species differ in their physiological responsiveness to anthropogenic changes, further emphasizing why spider monkeys have a higher extinction risk than howler monkeys. If these anthropogenic disturbances persist in the long term, elevated FGCM levels can potentially lead to a state of chronic stress, which might limit the future viability of populations.

## THE IMPACT OF CLIMATE CHANGE AND LAND USE CHANGE ON BORNEO'S ORANG-UTANS

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Many of the projected extinctions of terrestrial species are likely to take place in the humid tropics, with Southeast Asia experiencing the highest relative rate of deforestation. The Southeast Asian island of Borneo is home to a number of global conservation icons such as the endemic and endangered Bornean orangutan (*Pongo pygmaeus*). While the most immediate threat to orangutans and other Bornean wildlife is the continuing loss of forest habitat and hunting, it is now recognised that climate change could play an important detrimental role in the long-term future as well. On Borneo, climate models predict warmer lowland temperatures, a wetter interior, and seasonality to increasingly vary across the island. At the same time, a recent deforestation model predicts high rates of forest loss in the unprotected lowlands. Here, we present a MaxEnt modelling approach to delineate suitable orangutan habitat on Borneo while accounting for projected changes to climate and land-cover during the 21<sup>st</sup> century. Our models indicate that the effects of a changing climate under some forecasts could be especially severe and greatly exacerbate the ongoing threats from forest loss. By assessing simultaneously how the potential distribution of orangutan might be affected by these two overarching threats we are able to forecast possible best case and worst case scenarios under which an effective long-term conservation strategy for the species might be formulated.



## LAND USE AND LIVELIHOOD CHANGES: A MULTI-SCALED TRANSFORMATION PROCESS AMONG THE SHUAR IN THE ALTO NANGARITZA (SOUTH ECUADOR)

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The *Alto Nangaritza* is an area of biological importance due to its floral diversity and endemism. Nevertheless, due to multi-scaled land transformation processes, related to a historic-spatial advance of the colonization frontier, forest vegetation has been progressively changed into agricultural productive systems. Alongside, cultural practices of land use and livelihoods of Shuar communities are being replaced as well.

To determine options for sustainable land uses, a key issue is to understand the historical and spatial dimension of land use/ land cover changes (LULCC), land use transitions, their causes and driving forces. LULCC analysis at local scale was undertaken in the upper Nangaritza Valley in 2010. Similar to other agricultural frontier areas, the LULC changes were characterized by a substantial loss of lower tropical mountain forests (from 87% in 1986 to 38% in 2010) and a concomitant loss of biodiversity due to pasture expansion (increase of 27%). The colonization process was partly supported by the national government. The colonists were mainly Mestizos and Saraguros, who cleared vast areas of forest to establish extensive pasturing, threatening local biodiversity and affecting the traditional Shuar resource-use system.

In 2011 a livelihood survey was conducted in 45 Shuar households. Like other Amazonian ethnic groups, Shuar livelihood is still mainly based on shifting cultivation (27), fishing, hunting, and gathering. The forest is of great relevance to them and provides almost all basic needs. However, more and more Shuar are integrating into the market economy. Although monetary income mainly stems from the selling of food crops, 7 households reported cattle ranching as the main income source, and 6 households named timber logging. The results show that the colonization process and the pressure of the economic activities have already pervaded a footprint on the traditional Shuar land-use system. Especially by reducing available land for shifting cultivation high stress is put on the Shuar's traditional forest and biodiversity conserving resource use system. Therefore, a main goal in terms of conservation of lower tropical mountain forests should be the protection of traditional Shuar territory and the recognition of the environmental services that forest-dependent peoples, like the Shuar, provide.

## HOW DOES LOGGING INFLUENCE DYNAMICS OF TREE SPECIES DIVERSITY IN A TROPICAL RAIN FOREST IN THE BRAZILIAN AMAZON?

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Managing natural forests for wood production entails manipulating their structures and as a consequence changes in their dynamics and composition are unavoidable. Therefore, sustainable forest management requires an understanding of how these ecosystems respond to disturbances such as logging. In this context, the influence of selective logging on native tree species diversity is largely unknown in the tropics and data are often scarce. This complicates the assessment of logging influence, especially over time. Here, we present results on one of the few long-term studies of forest dynamics following logging in the humid neo-tropics. We investigated how tree species diversity responded to different disturbance intensities, compared to the features before logging and to an unharvested control treatment over a period of 30 years after the first logging in 1982. The study area is located in the Tapajós National Forest, Pará, Brazil. Disturbance intensities which comprised logging (1982) and thinning (1993-1994) ranged from 19 to 53% of basal area reduction in relation to its original value. Trees had been measured on 8 occasions in 41 permanent sample plots (0.25 ha). Dynamics of tree species diversity is presented considering the variations in species richness, diversity index and composition, including parameters such as changes in ecological groups and valuable timber species. These analyses enable to identify management implications of different disturbance intensities. Thus, the outcomes of this study will significantly help towards a better understanding of the dynamics and ecology of tropical rain forests in the Brazilian Amazon and they can support future decisions on sustainable forest management in this region.

**Merian Award Applicant**



## CO - DESIGNING AN AGENT - BASED MODEL OF BUSHMEAT HUNTING USING INTERACTIVE SIMULATIONS WITH A STYLIZED SCALE MODEL

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We present an agent-based model (ABM) on trapping of blue duikers (*Cephalophus monticola*) which was co-designed by local stakeholders in order to raise awareness about sustainability of bushmeat hunting in the periphery of Korup National Park, Southwest Cameroon. We conducted village meetings in three successive steps based on interactive simulations with a stylized scale model: During the first step, an abstract representation of a village surrounded by a portion of forest was co-designed by directly manipulating the computer interface displaying a spatial grid. Then, knowledge about the life-cycle traits and the behavior of blue duikers was shared through the demonstration of the individual-based population dynamics module of the ABM. The objective of the second step, introducing the hunting module of the ABM, was to elicit snare trapping practices through interactive simulation and to calibrate the hunting module by setting a value for the probability of a blue duiker to be caught by a snare trap. In a third step, a more realistic version of the ABM was introduced. The seven villages included in the process were located in the GIS-based spatial representation, and the number of "Hunter" agents for each village in the ABM was set according to the results of a survey. The demonstration of this realistic version triggered discussion about possible management scenarios, whose results obtained with the finalized version of the ABM was discussed during subsequent village meetings. We present the pros and cons of the method consisting in using at an early stage of the process interactive simulations with stylized scale models to specify empirically-based agent-based models.



## SMALL SCALE AND LARGE SCALE COMPARISONS OF ARBUSCULAR MYCORRHIZAL FUNGAL COMMUNITIES IN TROPICAL MOUNTAIN FORESTS IN SOUTH ECUADOR

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Arbuscular mycorrhizal fungi (Glomeromycota) are the most prominent mycobionts in the tropics and crucial for providing minerals to the vast majority of plants including nearly all tree species in the nutrient poor environments. Thus, knowledge of the mutualistic plant-fungus associations is indispensable for understanding the biology and ecology of tropical ecosystems. In contrast to surveys on birds, mammals, soil arthropods or aquatic animals, arbuscular mycorrhizal fungal communities have been rarely studied in the tropics. Because morphological features proved as insufficient to identify arbuscular mycorrhizal fungi, molecular methods are necessary. We analysed the communities of arbuscular mycorrhizal fungi at 1000 m in a premontane forest in the Podocarpus National Parc and at 2000 m in a lower montane forest in the Reserva Biologica San Francisco by sequencing part of the 18S rDNA. The sequences were classified in Operational Taxonomic Units (OTUs). We compare the communities on different scales (20 cm, 20 m, 1 - 2 km).



## NEW MORPHOLOGICAL CHARACTERS FOR THE DETERMINATION OF MARANTACEAE IN STERILE STAGE

Gerhard Kost<sup>1</sup>

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The Marantaceae are a pantropically distributed family of herbaceous and lianescent plants forming a characteristic element of the understory of tropical lowland rain forests. With approximately 550 species, it is the second largest family in the Zingiberales. The family is particularly diverse in the Neotropics where it is represented by an estimated 450 species with 29 genera, the most in middle and South-America. The biggest genus of Marantaceae with ca. 450 species is *Calathea*. The taxonomic arrangement of this family mostly is based on morphological characters of the flowers. Therefore a determination of vegetative specimens was almost impossible. Besides the sophisticated molecular analyses, information about the simple micro-morphological characters of the Marantaceae could be useful for the determination of sterile specimens.

In the National Park Piedras Blanca (Costa Rica) 22 species of the Marantaceae (*Calathea*, *Ctenanthe*, *Hylaeanth*e, *Ischnosiphon*, *Maranta*, *Marantachloa*, *Pleiotyachya*) were determined and macro-morphologically described by A Ruppel. These species represent the complete stock of Marantaceae of the area. Selected vegetative characters of the plants (epidermis cell structures, hairs, stomata) were analyzed by light microscope. This study revealed a high diversity of new morphological characters, which were not considered before. Additionally the distribution of leaf pigments, epicuticular waxes and crystal formation within the plant cells were analyzed. The variability of the new character was tested by a comparison of plant species grown in the natural habitats or cultivated in the Botanical Garden of the University Marburg. The character sets showed a high conformance in morphology and dimensions. These new data have a great taxonomic value and using them, it is possible to determine sterile specimens of all 22 species of the Marantaceae to the species level unambiguously.



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## INDEX OF PARTICIPANTS

Family name	First name	Organisation		Reference Page
Adhikari	Yagya	Geobotany, TUM	DE	116
Akintuyi	Akinlabi	Geography Dept, University of Lagos	NG	124
Armijos-Ojeda	Claudia	Inst. of Silviculture / TUM	DE	103
Ashton	Mark S.	Yale School of Forestry & Environmental Studies	US	26
Athayde	Eduardo	Universidade Estadual Paulista	BR	115, 164
Baldwin	Heather	Ulm University	DE	94
Banag	Cecilia	University of Santo Tomas	PH	67
Barua	Kamini	Leuphana University of Lüneburg, Germany	DE	
Bauer	Tina N.	TU Dresden - Tropical Forestry	DE	162
Beck	Erwin	Universität Bayreuth	DE	96, 102, 171
Beckschäfer	Philip	AWF, Göttingen University	DE	64
Beenken	Ludwig	ETH Zürich, Institut für Integrative Biologie	CH	135
Behling	Hermann	University of Göttingen	DE	44, 53, 98, 123, 141, 150, 166
Bendix	Jörg	University of Marburg LCRS	DE	96, 97, 102, 168, 171, 173
Berens	Dana	University of Marburg	DE	34, 35, 40, 78
Biagioni	Siria	Department of Palynology and Climate Dynamics Albrecht-von-Haller-Institute for Plant Sciences Georg-August-University Goettingen	DE	53
Bohr	Yvonne	Goethe-Uni Frankfurt	DE	
Boomkens	Mali	MSc Sustainable Tropical Forestry	FR	122

Family name	First name	Organisation		Reference Page
Brambach	Fabian	University of Göttingen - Ecology and Ecosystem Research	DE	136
Bräuning	Achim	University Erlangen-Nuremberg	DE	99, 158, 170
Breckle	Siegmar	Dept Ecology Bielefeld	DE	
Bregulla	Hannah	Universität Bayreuth	DE	43
Bröder	Linda	Universität Trier	DE	167
Buitron	Viviana	Institut für Geographie - FAU Erlangen-Nürnberg	DE	178
Burivalova	Zuzana	ETH Zurich	CH	114
Busch	Christin	freie Universität Berlin	DE	72, 161
Cárate Tandalla	Daisy	University of Göttingen	DE	142
Chen	Po-Wei	National Chung Hsing University	TW	
Cierjacks	Arne	Universität Hamburg/ Biozentrum Klein Flottbeck	DE	80, 113
Clancy	Cara	WWF	UK	
Corti	Nicolás	Institute of Forest Management, Technische Universität München	DE	68
Cvecko	Patrick	Institut of Experimental Ecology	DE	143
de Avila	Angela Luciana	University of Freiburg	DE	179
Djomo Nana	Eric	Charles University in Prague	CZ	155
Engel	Thomas	private	DE	
Enßle	Fabian	University Freiburg/ Remote Sensing and LIS	DE	69
Farwig	Nina	University of Marburg	DE	35, 40, 78, 168
Fiala	Brigitte	University of Wuerzburg	DE	149
Fischer	Anton	FG Geobotanik TUM	DE	116
Forget	Pierre-Michel	CNRS	FR	
Frank	Erik	University of Würzburg	DE	91
Fricke	Roman	Philipps University of Marburg	DE	117



Family name	First name	Organisation		Reference Page
Gallmetzer	Nina	Department of Tropical Ecology and Animal Biodiversity, University of Vienna	AT	74
Ganzhorn	Jörg	Hamburg University	DE	
Gebrekirstos	Aster	World Agroforestry Centre	KE	145
Geml	József	Naturalis Biodiversity Center	NL	133
Gérard	Anne	Georg-August-Universität Göttingen	DE	163
Gettkant	Andreas	Dt. Ges. fuer Internationale Zusammenarbeit (GIZ)	MX	
Glos	Julian	Hamburg University	DE	119
Gomez Diaz	Jorge Antonio	Georg-August-Universität Göttingen	DE	88
Gourlet-Fleury	Sylvie	Cirad Agricultural Research for Development	FR	29, 110
Grass	Ingo	University of Marburg	DE	34, 35
Gray	Claudia	Oxford University	UK	73
Guerrero Moreno	Naret	TUM	DE	75
Günter	Sven	CATIE Centro Agronómico Tropical de Investigación y Enseñanza, Costa Rica	CR	31, 103
Gutiérrez Ortega	José Said	Chiba University	JP	81
Harich	Franziska	University of Hohenheim	DE	121
Haug	Ingeborg	University of Tübingen, Evolutionary Ecology of Plants	DE	181
Heideroth	Antje	Philippsuniversität Marburg AG Mykologie	DE	
Heymann	Eckhard W.	Deutsches Primatenzentrum	DE	176
Hildebrandt	Patrick	Institute of Silviculture, TUM	DE	173
Hiltner	Ulrike	Inst. für Geographie, FAU Erlangen	DE	158



Family name	First name	Organisation		Reference Page
Hochkirch	Axel	Trier University	DE	77, 139, 167
Hohnwald	Stefan	Landscape Ecology, Institute of Geography, University of Göttingen	DE	
Homeier	Jürgen	University of Göttingen	DE	105, 106, 141, 142, 144, 151, 168, 169, 173
Houadria	Mickal	Institute of Zoology	DE	41
Igl	Jana	TUM	DE	72, 161
Ismail	Sascha	Freie Universität Berlin, BGBM	DE	48, 137
Janeček	Ľtěpán	Institute of Botany ASCR	CZ	37, 155
Jantz	Nele	Uni Göttingen	DE	98, 123, 141
Karnagel	Maria	Leuphana Universität Lüneburg	DE	
Kashyap	Jyoti	TERI University	IN	54
Kazmierczak	Martin	UFZ Leipzig	DE	132
Kerner	Janika	TU München	DE	72, 161
Kettle	Chris	ETH Zurich	CH	38, 39, 48, 146
Kieck	Julia Susanne	University of Hamburg, BZF	DE	80
Kieslinger	Julia	Department of Geographie, FAU Erlangen	DE	
Kindu	Mengistie	Institute of Forest Management, Technische Universität München	DE	66, 68
Kleinn	Christoph	Georg-August-Universität Göttingen, Abteilung Waldinventur	DE	64, 65
Knoke	Thomas	Technische Universität München	DE	66, 68, 70, 71
Kobbe	Susanne	University of Hamburg	DE	108
Kölbl	Angelika	Lehrstuhl für Bodenkunde, TU München	DE	128



Family name	First name	Organisation		Reference Page
Kollmann	Johannes	Restoration Ecology, TUM	DE	75, 84, 90
Koschova	Michaela	Institute for Environmental Studies, Charles University	CZ	175
Kost	Gerhard	Philipps Universität Marburg	DE	130, 134, 182
Kramer-Schadt	Stephanie	IZW	DE	159, 177
Kretzschmar	Petra	Leibniz Institute for Zoo and Wildlife Research	DE	159
Kübler	Daniel	Uni Hamburg - World Forestry	DE	59
Kurz	Holger	BfBB	DE	
Lapinski	Witold	Institute f. Experimental Ecology - Biology III	DE	92
Legelli	Julia	university Bayreuth	DE	147
Lin	Teng-Chiu	National Taiwan Normal Univ.	TW	95
Lindner	André	TU Dresden - Tropical Forestry	DE	101, 162
Link	Roman	Universität Göttingen	DE	169
Linsenmair	Karl Eduard	Biozentrum, Uni Würzburg	DE	91
Lippok	Denis	Institute of Biology/Geobotany and Botanical Garden, Martin-Luther-University Halle-Wittenberg	DE	55
Luke	Sarah	University of Cambridge, UK	UK	118
Mai Phuong	Nguyen	World Agroforestry Centre	VN	62
Matenaar	Daniela	Trier University	DE	139, 167
Mei	Tingting	Göttingen University	DE	165
Morgan	Emma	ETH Zürich	CH	39
Morin	Julie	ULg - Gembloux Agro - Bio Tech	BE	110
Mosandl	Reinhard	Institute of Silviculture, TUM	DE	
Müller	Verena	NeFo	DE	
Müller	Anke	TU München	DE	72, 161
Muthoni	Francis	University of Twente-ITC	NL	61

Family name	First name	Organisation		Reference Page
Naegeli de Torres	Friederike	University of Leipzig / Insitute of Geography	DE	50
Neuschulz	Eike Lena	Biodiversity and Climate Research Centre Frankfurt (BiK-F)	DE	
Niekisch	Manfred	Zoologischer Garten Frankfurt	DE	
Nopper	Joachim	Universität Hamburg	DE	108
Odongo	Vincent	Universiteit Twente	NL	60
Osen	Kristina	Philipps University Marburg	DE	156
Padysakova	Eliska	Institute of Botany, Czech Academy of Sciences	CZ	36, 155
Palumbo	Ilaria	Joint Research Centre	IT	57
Parolin	Pia	University of Hamburg	DE	46, 51, 148
Paul	Carola	Institute of Forest Managment	DE	71
Paulick	Sebastian	UFZ Leipzig - Dept Ecol Mod	DE	107
Peña-Claros	Marielos	Wageningen University	NL	30
Peque	Dennis	Georg-August-Universität Göttingen	DE	153
Peres	Carlos	Conservation Ecology, School of Environmental Sciences, University of East Anglia	UK	25
Pérez Postigo	Isabel	Philipps Universität Marburg	DE	
Peter	Franziska	Philipps Universität Marburg	DE	40
Peters	Thorsten	Intsitute of Geography, FAU Erlangen-Nuremberg	DE	99, 100
Pfeiffer	Simone	University Goettingen, CBL-SeTSAF	DE	
Pino Garay	Delicia	University of Bayreuth	DE	
Plugge	Daniel	Uni Hamburg - World Forestry	DE	63
Pohle	Perdita	Institue of Geography, University Erlangen-Nürnberg	DE	178
Poliakova	Anastasia	Georg-August-University	DE	150



Family name	First name	Organisation		Reference Page
Popa	Flavius	University of Marburg	DE	134
Portaccio	Alessia	University of Padova - Land, Environment, Agriculture and Forestry Department (TESAF)	IT	79
Prescott	Graham	University of Cambridge	UK	87
Pucha Cofrep	Darwin	University of Erlangen-Nuremberg	EC	99
Quichimbo Miguitama	Pablo	TU-Dresden	DE	
Riemann	Jana Carina	University of Hamburg	DE	119
Rodrigues	Jackson	University of Göttingen	DE	123, 166
Rose	Andreas	Institute of Experimental Ecology - University of Ulm	DE	143
Rubanza	Chrispinus	The University of Dodoma	TZ	138
Rutishauser	Ervan	Cirad	FR	111
Rutten	Gemma	Institute of plant science / University of Bern	CH	109
Sagra	Javier	Georg-August-Universität Göttingen	DE	144
Saint-Paul	Ulrich	Leibniz Center for Tropical Marine Ecology	DE	
Saito	Nathalia S.	National Institute for Space Research - INPE	BR	157
Sam	Katerina	Biology Centre AS CR	CZ	49
Schellenberger Costa	David	University of Oldenburg	DE	131
Schmerbeck	Joachim	TERI University	IN	52, 54, 56, 58
Schmitt	Christine	University of Freiburg	DE	42, 172
Schnetter	Marie-Luise	Bot. Institut, Gießen, guest	DE	154
Schüler	Lisa	Plant Systematics, Bayreuth University	DE	44

Family name	First name	Organisation		Reference Page
Schulze	Christian H.	Dept. Tropical Ecology and Animal Biodiversity, University of Vienna	AT	74, 174
Senior	Michael	Department of Biology, University of York	UK	47
Settele	Josef	UFZ - Helmholtz Centre for Environmental Research	DE	126
Silva	Brenner	Philipps-Universität Marburg	DE	102, 156, 171, 173
Singh	Akanksha	Technische Universität München	DE	93
Smith	James	ETH Zurich	CH	38, 146
Sommer	Simone	University of Ulm	DE	
Songer	Melissa	Smithsonian Conservation Biology Institute	US	76
Spannl	Susanne	Institute of Geography, Friedrich-Alexander University Erlangen-Nuremberg	DE	170
Stein	Katharina	University of Wuerzburg, Department of Animal Ecology and Tropical Biology	DE	
Stimm	Bernd	Silviculture TUM	DE	103
Strey	Robert	Institut for Soil Science Hannover	DE	86
Strey	Simone	Institut für Bodenkunde -Leibniz Universität Hannover	DE	85
Thornton	Sara	University of Leicester	UK	160
Todzro	Simon Anoumou Komi	NGO CFAPE-Togo	TG	
Tropek	Robert	University of Basel	CH	120, 155
Tschapka	Marco	University of Ulm	DE	92, 94, 143
Tscharnke	Teja	Georg-August-Universität Göttingen	DE	
Tsuda	Yoshiaki	Evolutionary Biology Centre, Uppsala University	SE	137



Family name	First name	Organisation		Reference Page
Türke	Manfred	Technische Universität München	DE	127
Velescu	Andre	University of Bern	CH	105
Vidaurre	Marolyn	TU Dresden - Tropical Forestry	DE	125
Waltert	Matthias	Georg-August-Universität Göttingen	DE	180
Wantzen	Karl M.	CNRS UMR CITERES	FR	82, 83
Weber	Michael	Inst. of Silviculture, TUM	DE	71
Wilms-Posen	Nico	University of Copenhagen	DE	122
Wilting	Andreas	Leibniz Institute for Zoo and Wildlife Research (IZW)	DE	177
Wittig	Roman	Max Planck Institute for Evolutionary Anthropology (D), Department of Primatology, Leipzig	DE	28
Zeilinger	Joerg	Philipps-Universität Marburg	DE	



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