

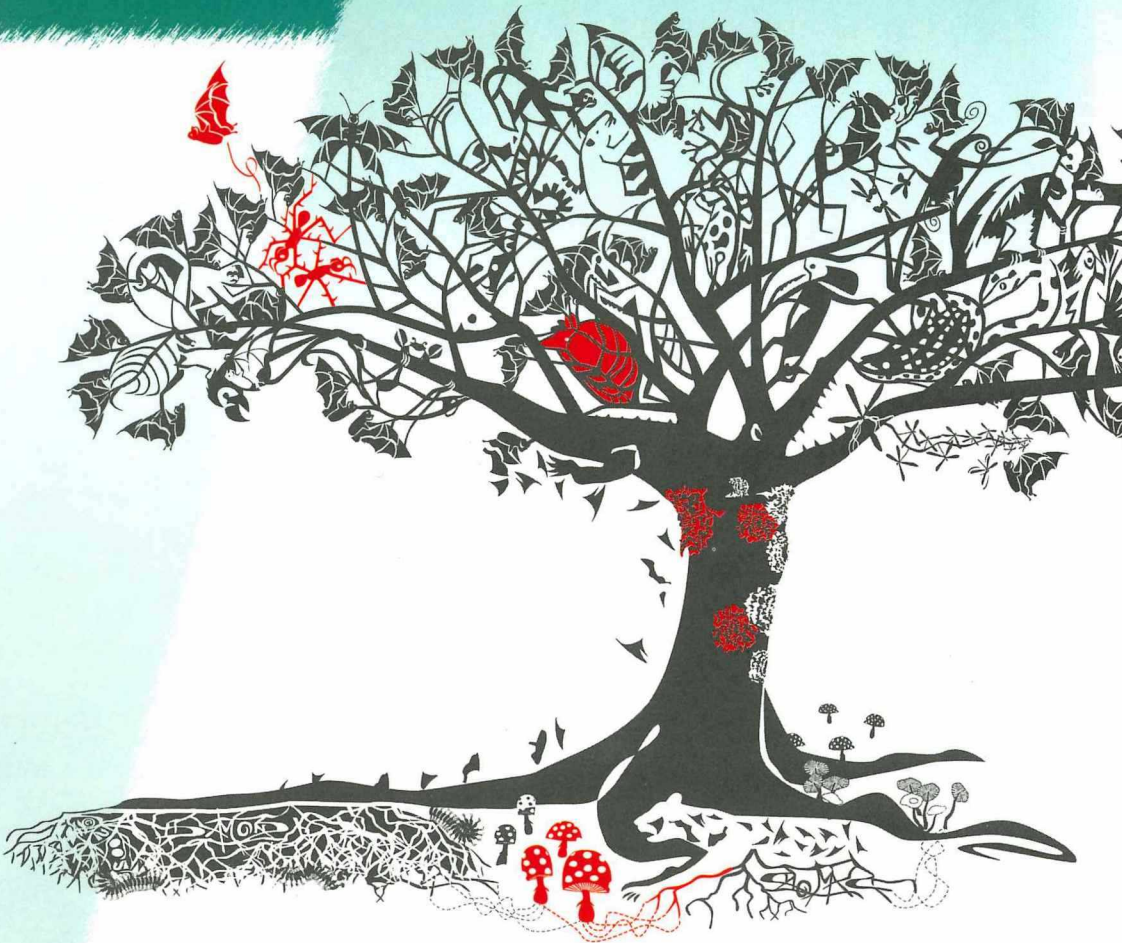


Society for
Tropical Ecology

Connecting microbes, plants, animals, and human impact

February 21–24, 2006
Kaiserslautern, Germany

19th Annual Meeting



 **Rheinland-Pfalz**
Ministerium für Wissenschaft,
Weiterbildung, Forschung und Kultur

DFG
Deutsche Forschungsgemeinschaft

 **TECHNISCHE UNIVERSITÄT
KAISERSLAUTERN**

Society for Tropical Ecology (gtö)

19th Annual Conference

**"Connecting microbes, plants, animals
and human impact"**

University of Kaiserslautern

February 21-24 2006

**Program
and
Abstracts**

Hosted by:

University of Kaiserslautern
Department of Plant Plant Ecology & Systematics
Department of Ecology
P.O. Box 3049
67653 Kaiserslautern
Germany



Departments: Plant Ecology & Systematics
Ecology

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Prof. Dr. Paulo S. Oliveira, Univ. de Campinas, Brazil
Prof. Dr. Robbert Gradstein, Univ. of Göttingen, Germany
Prof. Dr. Timm Hoffman, Univ. of Capetown, South Africa
Prof. Dr. Teja Tschardtke, Univ. of Göttingen, Germany
Prof. Dr. Rodolfo Dirzo, Stanford University, USA

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Sponsoring Institutions

We are grateful to all Institutions that gave financial support or donations.



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Tel. 06 31 / 3 66 75-0 • www.betten-ziegler.de

Betten... Ziegler, Kaiserslautern sponsored the public evening lecture with Christian Ziegler

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BIOGIS Consulting, Wals-Siezenheim, Austria sponsored valuable software licenses for our gtö2006-contest: Spot the animals. sponsored



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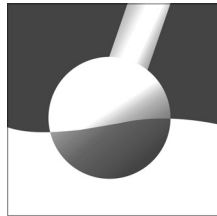
The *Bischoff Brewery*, Winnweiler, sponsored the public evening lecture with Christian Ziegler



Dojani & Schreiber Computer GmbH, Kaiserslautern, provides us with computer hardware for the conference.



The *Deutsches Rotes Kreuz*, Kaiserslautern supports our coffee breaks.



The *Gemeinschaftspraxis Dr. Dr. Klein & Dr. Schmitt*, Kaiserslautern sponsored the public evening lecture with Christian Ziegler



The Stadtparkasse Kaiserslautern sponsored the exhibition of Christian Ziegler and invites all participants to the exhibition opening.



The TWK, Technische Werke Kaiserslautern provides us with fresh water during the conference.

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Welcome

In past years, human impact and global change have been acknowledged as major threats to biodiversity, ecosystem function and human welfare world wide. Especially in the tropics this has substantial environmental and societal implications, and raises the requirement of basic ecological research and scientifically sound strategies for an appropriate integration of conservation and land-use practices.

During the last decades, scientists have probed the secrets of tropical ecosystems and they have achieved a better understanding of these complex environments. But the job is far from done, and time is of the essence since the subject of our studies is diminishing rapidly all over the tropics.

We are trying to understand what is vanishing in an attempt to conserve it. This ironic race has made the task even more complex. New subjects are constantly added to the curricula of tropical biologist.

For this congress, we have tried to address current issues of concern by focusing on four daily topics including 1) *Human Impact & Global Change*, 2) *Organism Interactions*, 3) *Biodiversity*, and 4) *Human Impact & Conservation*. Because of the increasing awareness of the ecological significance of microbial organisms, such as bacteria, algae, and fungi, this 19th annual meeting will especially emphasize the objective of "*Connecting microbes, plants, animals and human impact*".

It is the sincere wish of all of us in the Organizing Committee that this meeting lives up to the long *gtö* tradition of fostering the understanding of tropical ecosystems. The relative high attendance of students and researchers from both tropical and neighbouring European countries to this event points to a promising trend for future *gtö* meetings.

It is a challenging time for tropical biologists: a time in which renewed enthusiasm and energy is critical, a time to learn and develop imaginative approaches. Events like this will undoubtedly contribute to the creation of new approaches, cooperations, and advance the knowledge about the tropics. Let us all enjoy it and learn from it.

Rainer Wirth and Michael Lakatos
for the Organizing Committee

Welcome by the President of the University

Dear participants, dear colleagues,

it is a great pleasure for me to welcome you to the 19th annual meeting of the Society for Tropical Ecology (gtö) 2006 at the University of Kaiserslautern.

At present, around 70% of the world's population lives in the tropics, an area covering almost half of the Earth's surface. But more than three-quarters of the remaining pristine landscapes in the tropics has been destroyed in the last 50 years by ruthless overexploitation in the course of economic development and land-use change. Many ecological communities in the tropics have already been severely damaged and an ever-increasing number of these unique ecosystems are threatened with complete extinction.

If this present trend continues over the coming decades, we face the disappearance of millions of species, with unforeseeable ecological, economical, scientific and other negative consequences for those of us alive today and for all subsequent generations.

To prepare scientifically based concepts for the long-term preservation, and where possible restoration, of tropical ecosystems, as well as for the economically and ecologically sustainable exploitation of natural resources, represents the greatest challenge for tropical ecology research.

The 19th annual meeting of the Society for Tropical Ecology represents one step for finding resolutions of these challenges. I wish all participants success on this way and I hope you will enjoy the time at the University of Kaiserslautern, too.

I express my thanks to the organization team from the department of ecology and the department of plant ecology and systematics which have realized this important meeting and to the Stadtparkasse Kaiserslautern who enabled the exhibition of Mr. Zieglers work in his hometown.

Prof. Dr. Dr. Ing. h.c. Helmut J. Schmidt
President of the University of Kaiserslautern

Preface by Rodolfo Dirzo, Stanford University

Tropical forests: Continuous source of bio-novelty and the need for conservation of processes

In this contribution I have the objective of addressing two major preoccupations regarding tropical forests: i) the hitherto limited efforts dedicated to explore and document the overwhelming concentration of biodiversity and the exciting natural history underlying it, coupled with the formidable threats such biodiversity is facing, and ii) the need for conservation to go beyond the traditional, and by all means important conservation of taxa, to the conservation of populations and ecological processes.

Tropical forests are well recognized as the most biodiverse biome on land, as they contain a disproportionate representation of the terrestrial biota within a relatively small area. While species richness is the most highlighted aspect of their biodiversity, they are also exuberant in other facets of biodiversity, including life form (in the case of plants) or functional group (in the case of animals) diversity, as well as their concentration of endemic organisms at different taxonomic levels. However, despite their obvious potential to provide new and important bio-discoveries, they continue to be appallingly under-explored.

Yet, erratic as they are, incursions into tropical forests continue to provide evidence of biological novelties, including new organisms of high-taxonomic hierarchy. Representative examples of this include a remarkable bestiary of vertebrates ranging from new primates, fresh-water fishes and the smallest species known (or even imagined) of tetrapod: some salamanders in the Genus *Thorius* representing the extreme evolutionary attempt of miniaturization—animals with a skull a few millimeters long, capable of accommodating brain, ears, jaws and, sometimes, but not always, eyes. Novelties among the invertebrates are also numerous and spectacular, including plant ants that secrete herbicidal substances that selectively defoliate and eventually kill neighboring plants that are of no value to the ants, or represent potential competitors to their specific host plant. Fame for their massive migration, particularly for over wintering, is a monopoly of vertebrates, typically birds. In the tropics we are now becoming familiar with remarkable migrations of insects, including Lepidoptera, such as *Urania* spp., that move long distances for reasons still unknown, but with migration routes that track the distribution of specific host plants, all of them with peculiar attributes, particularly their novel secondary chemistry that determines hyper-specific trophic relationships with plants, in turn leading to a number of exciting evolutionary, ecological, conservational and even pharmacological implications.

Within the plant kingdom, novelties include remarkable discoveries of long-lived plants such as palms; a species of perennial corn, and entire families previously unknown to science which, not surprisingly, exhibit spectacular attributes. One example illustrates this point. In the recently discovered plant family of Lacandoniaceae, *Lacandonia schismatica* exhibits an unusual “the other way around” arrangement of floral parts (male parts in the center, female organs in the pe-

riphery!!!). Likewise, the concentration of tropical plant endemisms is not only important for their conservation implications (e.g., the definition of hotspots), but also for the novelty of some of them, including arborescent morning glories (genus *Ipomoea*)—yes: spectacular morning glories in the form of trees in Neotropical dry forests!!!

Such erratic bio-discoveries represent an essentially unread bio-library with promising possibilities for our understanding of life and our provisioning of new products of direct value to humans.

Nevertheless, as everyone knows, such biological wealth is seriously threatened in our Anthropocene era of human impact on nature. While our collective discussions have concentrated on the potential pulse of extinction of species, I urge us to also pay attention to, on the one hand, the impending risk of population extinctions. While the dramatic current deforestation and fragmentation has provoked our interest to estimate the numbers of species committed to extinction and society at large do not see such apocalyptic numbers becoming an obvious reality in our lifetimes, what is imminent, although as yet undocumented, is the magnitude and qualitative aspects of the extinction of populations at local levels. For example, the deforestation of tropical forests in Mexico or the Atlantic forests of Brazil implies the loss of distinct populations of plants and animals that, by virtue of being in the extreme distributions of the tropical biome in the Americas, represent biological extinctions of taxa at the local level, despite the fact that the species those populations belong to, remain elsewhere. I argue that we are likely to be generating massive population extinctions although the binomial Latin names of the species may not necessarily disappear. This is a critical agenda we need to address. On the other hand, it is at the local level that the presence or absence of species may matter the most, from the functional/ecological perspective.

The latter leads me to the final point of my contribution: the need for the conservation and restoration of ecological processes. The example of the disruption of plant-animal interactions illustrates my point. Tropical deforestation and fragmentation in Mexican forests lead to the local loss of numerous species of animals. Consider the case of tropical mammals. Due to hunting and habitat destruction, large- and medium-sized mammals are lost from such remaining forests. In the absence of seed-dispersing mammals, many tree species drop their seeds, in masse, in patches of high concentration. In turn, in the absence of large herbivores and seed predators, significant plant-mammal interactions such as herbivory, seed predation and non-trophic effects of trampling become cancelled. Therefore those anomalous seedling concentrations of some particular seedling species monopolize the forest understory with great potential to affect the regeneration patterns of tropical forests and auguring changes in the diversity of the understory plant community. Since the understory represents the forest of the future, the loss of mammals, indirectly affecting interactions with plants, threatens the most distinguishable attribute of tropical forests: their biological diversity. These studies suggest that, in addition to our justified preoccupation for the conservation of taxa, we need to be concerned, also, with the conservation of processes.

Finally, given that the current tropical landscapes are constituted by scattered fragments of wildland amidst human-dominated countryside, we need to address the urgent need of conserving the few remaining extensive tropical forests and to learn how to garden the countryside landscape, in the presence of human populations. The future of tropical biodiversity resides in those mosaics and in our ability to provide for the sustainable needs of the local inhabitants of those critical areas where most of the tropical biodiversity resides.

Rodolfo Dirzo,
Department of Biological Sciences,
Stanford University

Information for participants

How to reach the conference site

Travelling by car:

BAB A 6 (E12) Mannheim-Saarbrücken

BAB A 63 Kaiserslautern-Mainz

B 37 Kaiserslautern-Ludwigshafen

B 40 Saarbrücken-Mainz

B 270 Pirmasens-Lauterecken

Note: BAB = Bundesautobahn (=motorway); B = Bundesstraße (=A-road)

Travelling by train and bus:

You can use various connections to reach Kaiserslautern, including Intercity or municipal trains. There are connections to all destinations from the train station in Mannheim. It takes about five minutes by taxi from the train station in Kaiserslautern to the University.

Bus services: bus lines running to and from the University are the lines 5, 6, 7, 14, 15 and 6512

Travel by Plane:

Airport Saarbrücken-Ensheim (it takes one hour on the motorway 6)

Airport Frankfurt – Rhein-Main (it takes 1.5 hours on the motorway or 2 hours by train)

Airport Hahn (it takes 1.5 hours on the motorway 62)

Airport Zweibrücken (it takes one hour on the motorway 6 and 8)

Conference venue

Registration and the presentation of posters and talks including the public evening lecture will take place in the Audimax building (No. 42) in the west of the campus. You will find the way signposted once you reach the campus. A campus map is also shown on the back of this booklet. The conference desk will be placed in building 42 near lecture room No. 110.

Meals

Lunch and dinner is available in the refectory (Mensa; No. 30 see campus map) from 11.30 until 13.45 or 17.30 until 18.30. Food and snacks are available in the Cafeteria from 7.45 until 18.30 (Friday until 14.30). Both are located opposite to the Audimax. You may pay in cash at the free-flowing buffet and in the cafeteria. Please note that some menus (menue 1 and 2) of the mensa can only be paid with the Mensa card.

With this card you can pay your meals and snacks in the Cafeteria and the Refectory (Mensa) of the University of Kaiserslautern. You will have to deposit 5 Euro at the conference office in case you requested a card online (refund with return of the card). Registration for the Mensa Card over the database was possible until February 14, 2006. During the conference you can acquire a Mensa Card at the Cafeteria of the University of Kaiserslautern (building 30). There are also the terminals where you can load the card with money.

Students that can verify their student status will be charged student prices when paying with a Mensa Card. Others will be charged guest prices. In case you want to pay in cash you will be charged guest prices (independently from your status).

Alternatively, several restaurants are located via the university bridge within 5 minutes walking distance.

Special events

Exhibition

The "Stadtsparkasse Kaiserslautern" invites all participants of the 19th annual gtö meeting to visit the opening of the photo exhibition "A magic web" of the renowned nature photographer Christian Ziegler at Tuesday evening, February 21, at 7 pm. In this exhibition Christian presents the best of 15 months work in Panamanian rainforests (visit www.amagicweb.com or www.naturphoto.de). The Stadtsparkasse is located at the Stiftsplatz (multi-storey car park) in the center of the city.

Poster Party

The poster party will take place on Wednesday, February 22 in the lobby of the Audimax from 18.00 until 20.00. For your welfare some canapés will be served. Please contact the authors at their poster sites and consider to spot out your candidate for the Merian Price in the category: best poster presentation. The party will be continued after the evening lecture of Christian Ziegler.

Evening lecture

In a public evening lecture the renowned nature photographer Christian Ziegler will take us to the lush rainforests of Panama. The lecture will be held at 20.00 on Wednesday evening, February 22 in the Audimax (42-115) at the University of Kaiserslautern introduced by Prof. Dr. Dr. Ing. h.c. Helmut J. Schmidt the president of the University. After the evening lecture snacks and beer will be served to motivate getting in touch with the public.

Conference Dinner

On Thursday, February 23 we will offer a conference dinner (starting at 20.00) at the Restaurant und Tagungszentrum Betzenberg in the famous soccer stadium of Kaiserslautern, where 5 games of the FIFA Soccer World Cup 2006 will take place. An Italian menu will be served framed by an entertaining Latin band. After the dinner the restaurant will be open to all participants and we invite all of you to party.

Accommodation

For hotels and rooms please contact the:

Tourist Information

At the town hall

Willy-Brandt-Platz 1

67657 Kaiserslautern

Telefon: 0631 365-2317 oder -2316

Telefax: 0631 365-2723

touristinformation@kaiserslautern.de

<http://web2.kaiserslautern.de/tourismus/>

Accompanying program

ISPRS-workshop on Remote Sensing in the Tropics

Chair: Uwe Rascher & Christopher Small

The workshop on Friday, February 24 at 14.00 – ca. 17.00 (42-110) is organized by the workgroup VIII/4: Management and Research of Tropical Environments of the International Society for Photogrammetry and Remote Sensing (ISPRS). We aim to bring together remote sensing specialists on the one hand and scientists and decision makers on the other hand to identify remote sensing-based solutions that meet the needs of researchers, managers, and policy makers in relation to national and regional sustainable development in tropical areas. In order to facilitate a fruitful discussion we organized short presentations from either side:

- (i) the remote sensing specialist, who should present what they can actually measure using advanced remote sensing approaches
- (ii) ecologist, who propose questions/hypothesis from their work, which could benefit from remote sensing techniques and data.

The workshop will be open for everybody and is free for all participants of the gtö.

DFG-Meeting of Research Unit 402

Chair: Erwin Beck

The DFG-Meeting "Functionality in a Tropical Mountain Rainforest" will take place on Tuesday, February 21 in the building 57 (Rotunde). Tropical mountain rainforests are hotspots of biodiversity, but nevertheless are very labile ecosystems. The major threat originates from increasing land-use by a continuously growing human population.

The German research unit joins biologists, geoscientists, researchers in forestry and social anthropology in a multidisciplinary and comprehensive ecosystem study of a mountain rainforest in South Ecuador that extends from about 1200 to 3000 m a.s.l. In this area the pristine forest can be compared with several stages of its degradation originating from large- and small-scale human impact. In that respect the study objects are secondary forests, agricultural land and wide areas of former agricultural use which have been abandoned because of an ultimate takeover by extremely aggressive weeds. In addition to the analysis of the various ecosystems, a major aim of the research is to develop and implement methods of reforestation of the abandoned areas with indigenous trees. The findings will also allow conclusions for a sustainable use of the indigenous forest.

Merian Prize

The Society for Tropical Ecology and the organizers of the 19th annual meeting award the best poster and the best oral presentation with the Merian Prize, honouring Maria Sibylla Merian.

Eligible candidates are all students and all PhDs that finished their dissertation less than three years ago.

We want to encourage all participants of the 19th annual meeting to hand in their votes for the best oral and the best poster presentations. You will find your ballot paper in the conference bag. Prizes will be awarded to the three best poster and oral presentations each during the closing ceremony at Friday.



Please look for this symbol to find eligible candidates in this volume

The gtö Contest – spot the animal

Tropical ecosystems are hotspots of diversity. Damond Kylo illustrated this as a web of "arboreal interactions" in the conference logo.

Spot all the animals hidden in the tree from crown to roots and calculate the Shannon Wiener diversity index*.

Please fill out the corresponding form and hand it in no later than Thursday (Feb. 23) evening. The winner will receive one of the software licenses of Maps and BioMapper Extension for ArcGIS sponsored by BIOGIS CONSULTING.



* Find the definition at:
<http://www.snr.missouri.edu/natr211/topics/shannon.html>
 calculate the index at:
<http://www.changbioscience.com/genetics/shannon.html>

P/s: the leaf fragments are carried by leaf cutting ants of the species *Atta colombica*

Information for Authors

The schedule for all presentations is provided on the following pages (see conference program). It includes presentation numbers (Talk, session number, order; e.g. T12.1 or P3.5 for talks and posters, respectively) which are embedded in the abstracts in alphabetical order. You may also use the "Author Index" to locate abstracts.

Oral presentations

Our technicians would like to capture your power point presentations as you first arrive at the conference desk or at least **the day before your presentation**. The personnel at the registration desk will direct you to our technicians. We will be able to capture your PC-compatible presentation from your laptop, RAM stick or CD. We will transfer your presentation to the laptop to be used during your session. Please check that your presentation has no conversion errors. Four technicians and two assistants will handle power point presentations – we try that everything goes smoothly.

Posters

Posters may be installed in the lobby of the Audimax as early as Tuesday, February 21 at 9.00. Place your poster beneath the appropriate number (see instructions at the top of the page to determine your number). The two poster sessions will be on Wednesday, February 22 (short presentations of posters in sessions 1-7) and Thursday, February 23 (sessions 8-13) at 13.30 – 14.30. Each session will be introduced by a short poster presentation in the Audimax (42-115) at 12.00 – 12.30, where you have the opportunity to summarise your study within 45 seconds by one overhead foil. Please accompany your poster also on Wednesday evening during the poster party. Posters must be removed on Friday, February 24 by 17.30.

Conference Program

Tuesday, 21.02.2006: Human impact & global change

Room 42-115

- 09.00-14.00 Registration Setting up Posters, Handing in Talks
- 14.00-14.45 Opening Ceremony
Prof. Dr. B. Büdel (Organizing Committee)
Prof. Dr. W. Freeden (Vice - President Univ. of Kaiserslautern)
Prof. Dr. K. E. Linsenmair (President Society f. Tropical Ecology)
Prof. Dr. R. Dirzo (Stanford University, USA)
- 14.45-15.30 **Plenary Talk** p. 39
Tim Baker: The macroecology of Amazonian forests: understanding current and future trends in a changing ecosystem
- 15.30-16.00 Coffee Break

Room 42-115

- Session 1** **Ecology and global change in tropical forests** p. 47
(single) *Chair: Tim Baker*
- 16.00-16.15 T1.1 *Andreas Hemp: Climate change and its impact on the cloud forests of Kilimanjaro* p. 84
- 16.15-16.30 T1.2 *Ulrich Weber, Allan Spessa: Climate and Human Drivers of Fire Activity and Emissions from Peat and Vegetation Burning in Borneo, 1997 to 2003* p.124
- 16.30-16.45 T1.3 *Andreas Huth, Peter Koehler, Nadja Rueger: Impacts of different forest management strategies on structure and dynamics of tropical rain forests* p. 88
- 16.45-17.00 T1.4 *Helen Busby, Oliver Phillips, Timothy Baker: Resource supply versus species type: assessing the roles of light availability and species traits in driving productivity of trees in Amazonia* p. 64
- 17.00-17.15 T1.5 *Pierre L. Ibisch, Christoph Nowicki, Harald Schill: Global change management: a call for a new approach to the conservation and use of natural resources* p. 88
- 17.15-17.30 T1.6 *Musila Winfred, Todt Henning, Uster Dana, Althof Arnhild, Dalitz Helmut: Legacies of past anthropogenic disturbance on soil and tree composition in Kakamega tropical rainforest, Kenya* p.111
- 17.30-17.45 T1.7 *Kuo-Jung Chao, Oliver L. Phillips: Growing old in the Amazon: predicting tree mortality from prior performance* p. 65

17.45-18.00 T1.8 *Jens Illig, Stefan Scheu, Mark Maraun: Decomposition of two litter types (Purdiaea nutans, Graffenrieda emarginata) in a tropical montane rain forest in southern Ecuador* p. 90

19.00-21.45 Exhibition Opening "A magic web", photographs from Christian Ziegler at the "Stadtsparkasse Kaiserslautern"

Wednesday, 22.02.2006: Organism interactions

Room 42-115

08.30-09.15 **Plenary Talk** p. 42
Paulo S. Oliveira: Dual seed dispersal systems: Interactions between ants and fleshy diaspores in the tropics

Session 3 (single) Fungi-plant interactions p. 47
Chair: Damond Kylo

09.15-09.20 T3.1 *Burkhard Budel: Preface: The role of plant-fungi interactions in the gto*

09.20-9.45 T3.2 *Damond Kylo, Luis Mejia, Klaus Winter, Edward Allen p. 99*
Herre: Fungi versus fungi: a critical defense mechanism of the host plant

9.45-10.00 T3.3 *Sabrina Setaro, Michael Weiss, Franz Oberwinkler, Ingrid p.118*
Kottke: Neotropical Ericaceae and their mycorrhizal fungi

10.00-10.30 Coffee Break

Room 42-115

Session 2 (single) Plant-Animal Interactions: pollen and seed dispersal p. 47
Chairs: Pierre-Michel Forget & Eckhard W. Heymann

10.30-10.45 T2.1 *Clemens Schlindwein, Paulo Milet-Pinheiro, Airton T. Carvalho, Reisl O. Darrault: Euglossine bees (Apidae, Euglossini) in the Northern Atlantic Rainforest of Brazil: Diversity, habitat requirements and importance as specialized pollinators* p.112

10.45-11.00 T2.2 *Elisabeth Kalko, Njikoha Ebigbo, Jakob Fahr, Wibke Thies: p. 91*
Advertisement and demand: what plants want and what frugivores make out of it

11.00-11.15 T2.3 *Daniel Piechowski, Gerhard Gottsberger: Parkia pendula p.114*
and the mammals: herbivory, pollination and dispersal

11.15-11.30 T2.4 *Pierre-Michel Forget, Eckhard W. Heymann, Joanna Lambert: The size of primate-dispersed seeds – a comparison* p. 72

		between Paleotropics and Neotropics	
11.30-11.45	T2.5	<i>Joanna Lambert</i> : From fungus to human resource use: the conservation implications of primates as seed dispersers.	p.101
11.45-12.00	T2.6	<i>Nina Farwig</i> , Bärbel Bleher, Katrin Böhning-Gaese: Does improved seed dispersal service account for increased genetic exchange?	p. 70
12.00-12.30		Poster presentation of session 1-7	p. 28
12.30-13.30		Lunch Break	
13.30-14.30		Poster Session (session 1-7)	

Room 42-115

Session 4 (parallel)		Trophic and plant-herbivore interactions <i>Chair: Nico Blüthgen</i>	p. 47
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20.00-21.00 **Evening lecture by Christian Ziegler**

welcome address by Prof. Dr. Dr.-Ing. h.c. H.J. Schmidt, President of the University of Kaiserslautern

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Tropical ecosystems in transition: regeneration processes and conservation Strategies

Chairs: Jaboury Ghazoul

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- 12.00-12.15 T13.5 *S. Günter, O. Cabrera, Michael Weber, B. Stimm, R. Mosandl: Natural Forest Management in Neotropical Mountain Rain Forests - An Ecological Experiment* p. 79
- 12.15-12.30 T13.6 *Simone Goda Sporn, Robbert Gradstein: Do epiphytic layers have a negativ impact on cacao production?* p.121

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13.00-14.00 Lunch Break & Departure

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14.00-17.00 ISPRS workshop on remote sensing in the tropics

Chairs: Uwe Rascher & Christopher Small

- 14.00-14.30 *Uwe Rascher: Understanding the spatio-temporal variations of tropical plant ecosystems - An overview of integrated ecological and remote sensing studies to better understand function and structure in tropical environments.*
- 14.30-15.00 *Christopher Small: What we can measure - the remote sensing perspective*
- 15.00-15.30 Contribution of participants
- 15.30-16.00 Coffee Break
- 16.00-16.30 What we want to know - the biological perspective
- 16.30-17.00 Compilation of a summarizing concept paper

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Plenary Speakers - Abstracts

The macroecology of Amazonian forests: understanding current and future trends in a changing ecosystem

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Amazonian forests contain approximately 40 % of the biomass stored in terrestrial ecosystems and more than half of global biodiversity. Predicting the effects of global environmental change on these forests requires an understanding of the ecological mechanisms that determine current patterns of forest composition, structure and dynamics. For example, is resource availability, or disturbance, more important for determining variation in forest turnover and growth rates? What role does species composition have in determining ecosystem properties? These questions have been addressed using long term data from a network of forest inventory plots across Amazonia. These plots show that there are regional scale spatial patterns in species and functional composition, aboveground biomass, wood productivity, tree mortality and recruitment rates, and the stocks and decomposition rates of coarse woody debris. Edaphic, rather than climatic, conditions correlate with higher rates of forest turnover and growth rates in western Amazonia, and compositional patterns determine variation in forest biomass.

These spatial patterns are important because they have provided the context for concerted increases in tree mortality, recruitment and growth rates, and forest biomass. Overall, these trends indicate that Amazonian forests have increased in productivity and carbon storage and are most plausibly explained by increasing resource levels. The known spatial variation in forest productivity, structure and composition therefore provides a range of predictions about the future of intact Amazonian forests. In particular, increases in the abundance of species with low wood density as a result of elevated rates of tree turnover, may reverse currently observed increases in forest biomass. The ecological processes and changes in intact forests need to be considered alongside more direct alteration of tropical forests from logging, land use and climatic changes, to determine effective conservation strategies and the future contribution of these biomes to the global carbon cycle.

Bryophyte assemblages of tropical rain forests - responses to forest modification and global warming

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Tropical rain forests because of their structural complexity and favorable microclimatic conditions are a rich habitat for bryophytes. Owing to the lack of a protective cuticle, solutions and gases may enter freely into the living tissues of these plants causing sensitive reactions of these plants to changes in the environment. Because of this, bryophytes are good ecological indicators. Based on results of our work in tropical America and Asia I will discuss spatial patterns of bryophyte diversity in different rain forest types, responses to forest modification, and the possible impact of global warming on bryophyte diversity. Evidence from bryophytes allows for recognition of new, hitherto overlooked type of rain-forest: the Tropical Lowland Cloud Forest (TLCF) with record-high diversity. Analysis of bryophyte assemblages along disturbance gradients shows that old-growth primary forests are not necessarily more diverse than secondary ones. Diversity in plantations and on remnant trees, however, is significantly reduced. Canopy closure is an important parameter influencing bryophyte diversity along the disturbance gradient. Similarity in species composition of secondary and primary forests increases with forest age but after 40 years of succession many primary forest species had not re-established in secondary forest, indicating that long time is needed for recovery of bryophyte communities. The possible impact of global warming on tropical bryophyte diversity was studied by translocation of bryophyte assemblages along temperature gradients in the Andes. The results show species-specific responses to transplantation after two years and indicate that community structure and species composition of bryophytes in tropical rain forests may be significantly modified as a result of future temperature increases of two or more degrees.

Global change and human impacts on biodiversity in Namaqualand, South Africa

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Two perceived threats face the biota of Namaqualand. Firstly, recent modelling efforts suggest that climate change will impact heavily on the diversity and agricultural production of the region as a result of a reduction in rainfall and an increase in temperature over the next 50 years. Secondly, the expansion of communal land under South Africa's land reform programme could lead to higher stocking rates over a significant portion of Namaqualand on a scale not seen in the region since the 1950s. This trend could be exacerbated as a result of the downscaling of mining operations in the region and the retrenchment of workers who use their severance packages to invest in livestock production. To investigate these issues we take an historical perspective. We look at historical trends in rainfall over the last 100 years and incorporate recent interpolation studies carried out by colleagues within the BIOTA South research programme. Evidence for the impact of climate change is investigated for two long-lived tree *Aloe* species growing in the broader Namaqualand region. The apparently contradictory results suggest that responses to drought and high rainfall events are complex and the life history dynamics of long-lived species need to be better understood. The historical impact of human society in the region from pre-colonial to recent times is also outlined. Changes in the area cultivated and stocking rate for communal and private land suggests that the last two decades has seen a significant decline in the agricultural use of the land. While the low-lying bottom lands continue to be the most heavily exploited, increased urbanisation in the region has drawn a large number of people off the land, particularly in the last few decades. Improved infrastructural development in the rural areas of Namaqualand has also meant that people are now less reliant on natural resources for their day-to-day activities. Firewood production in a recently-electrified rural village, for example, has seen a 75% reduction in fuelwood consumption. The strong environmental history and repeat photography approach undertaken in this analysis suggests that Namaqualand's landscapes are similar to what they have looked like in the last 100 years. If anything, there is more vegetation cover today than there was 50 years ago and there is little evidence of widespread desertification in the region. Land use impacts were probably greatest in the first half of the 20th century and have declined in the last 50 years.

Dual seed dispersal systems: Interactions between ants and fleshy diaspores in the tropics

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In tropical forests nearly 90% of the shrubs and trees bear fleshy fruits and rely on vertebrate frugivores for seed dispersal. Thus most studies on seed dispersal of tropical species have hitherto focused on fruit consumption and seed deposition patterns generated by primary, vertebrate seed dispersers. However, large amounts of the fruit crop produced by tropical trees can reach the forest floor intact, spontaneously or dropped by vertebrate frugivores. Because tropical ground-dwelling ants are remarkably abundant and diverse, a wide range of interactions between ants and fallen fleshy diaspores is expected to occur in tropical habitats. These ant-diaspore interactions can affect seed biology (germination), modify seed fate, and markedly affect patterns of recruitment (distribution and survival of seedlings) in primarily vertebrate-dispersed species lacking adaptations for ant-dispersal. Such an influence of secondary dispersers enhances the complex, two-phase nature of the dispersal ecology of tropical tree species. Untangling the complexity of such dispersal systems (with sequentially-connected phases) is crucial for understanding the evolutionary relationship between frugivores and plants, and plant regeneration pathways. Mutualisms are less conspicuous in dispersal systems than in more tightly coevolved systems, and interactions between ants and fleshy diaspores are highly unpredictable and variable. Indeed, the intricacy of the mutualistic networks within such dispersal systems may underlie the biotic complexity and high diversity of tropical ecosystems.

Plant-insect diversity and ecosystem functioning in human-dominated tropical landscapes

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The modification of tropical landscapes through human exploitation of the environment continues to reduce biodiversity on a global scale. This decline in biodiversity has led to concern over the potential loss of major ecosystem processes. Further, agricultural land use and biodiversity conservation have been traditionally viewed as incompatible, but only recently, recognition has increased that a restriction of conservation efforts to natural, undisturbed ecosystems is of limited value. Agriculture can make important contributions to high diversity of landscapes, while it also benefits from sustainable ecosystem services provided by agricultural conservation management at local and regional scales. For example, enhanced biological pest control and improved crop pollination may directly increase the farmers' income.

In this presentation, I will refer to results on patterns of biodiversity and plant-insect interactions, changing with spatial and temporal scales considered, from the Collaborative Research Centre "Stability of Rainforest Margins in Indonesia" (STORMA, SFB 552) and the BioTEAM (BMBF) research program on the "Evaluation of biological diversity of land-use systems in a mega-diverse region of Ecuador" (Bio-Sys).

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Sessions – Abstracts

1 Ecology and global change in tropical forests

Chair: Tim Baker

The aim of this symposium is to assess the state of ecological knowledge for predicting the impacts and implications of anthropogenic global change processes on tropical forest ecosystems. All contributions, based on experimental, modeling, field monitoring or remote sensing approaches, that address relevant ecological processes and/or direct or indirect human impacts will be considered. However, ideally, they will provide more than local case studies unless such case studies are shown to be especially relevant. Examples of the kinds of issues and questions we wish to explore include (1) studies relevant to key ecological processes, e.g. "How important is treefall disturbance for maintaining the diversity of tropical forests?"; "What is the relationship between tropical forest diversity and productivity? (2) long term studies of tropical forest structure and dynamics, in the context of global change processes, e.g. "To what extent are atmospheric changes affecting the carbon balance of tropical forests?" "What evidence is there for species compositional shifts in tropical forests in response to global change processes?" (3) studies that address the practical implications of global change for tropical forests e.g. "What are the implications of global change for conserving tropical biodiversity?"

2 Plant-animal interactions: pollen and seed dispersal

Chairs: Pierre-Michel Forget & Eckhard W. Heymann

This symposium will bring together speakers who address different issues in the study of a specific animal-plant interaction, namely pollen and seed dispersal. Topics to be addressed range from the analyses of specific plant-disperser systems on local scales to comparative analyses of plant-disperser co-evolution or co-adaptation on continental scales and across continents. The symposium will also address deficits in our current knowledge on pollination and seed dispersal will conclude with suggestions for future studies.

3 Fungi-Plant interactions

Chair: Damond Kylo

The meeting logo illustrates the topic of connections, but it was also drawn to demonstrate that plants are not just green, but a chimaera of organisms, specifically fungi. Plants are lichens turned inside out. Leaves are filled with an unbelievable diversity of endophytic fungi hidden within the tissue and with hidden significance. Root function depends on mycorrhizal fungi extending throughout the soil into a vast network. Fungal pathogens and herbivores not only must overcome plant defenses, but the mutualistic fungi as well. This symposium will attempt to expand our view of plants and rethink how their interaction with fungi affects all aspects of plant ecology and evolution.

4 Trophic and plant-herbivore interactions

Chair: Nico Blüthgen

Multispecies communities may be driven by various mechanisms, although two forces are usually distinguished: bottom-up and/or top-down control. The impor-

tance of both mechanisms in different ecosystems of variable complexity and productivity has been debated extensively in recent studies. This symposium attempts to cover a variety of topics and approaches such as interactions between herbivores and their host plants or natural enemies, decomposition, food webs, and nutrient or biomass flows between trophic levels. Participants are encouraged to emphasise a broader community perspective of their selected systems. Contributions will be highly welcome from any field of trophic interactions and herbivory.

5 Social insects

Chair: Hubert Herz

Tropical systems harbour the greatest diversity of social insects and give ample opportunities to study their ecology and evolution. For this symposium contributions are invited from a wide array of topics including behavioural ecology, social insects as ecosystem engineers, the applied use of social insects as bioindicators and control agents in agro-forestry systems, and their potential problems as invasive pests.

6 Free Contributions

Chair: Elisabeth Kalko

Contributions from all fields of tropical ecology are welcome.

7 Species distribution and community composition: patterns and processes

Chair: Bettina Engelbrecht

Understanding patterns of species distribution and community composition are major themes in ecology. In highly diverse tropical systems, describing these patterns and understanding the underlying mechanisms remain major challenges. Various biogeographical, statistical, modelling and experimental approaches are used to address these issues at different levels of complexities and scales. The resulting new insights contribute to our basic understanding of ecological processes, and are crucial for developing effective conservation strategies and for modelling consequences of global change. Contributions from all taxonomic groups and tropical systems are welcome.

8 Biodiversity and ecosystem functioning

Chair: Uwe Rascher

High biological diversity, changing environmental conditions, and forest structural variation often combine in a complex regional mosaic of responses in tropical ecosystems. In this session we will focus on various aspects of species distribution, biological diversity and ecosystem processes in this heterogeneous environment.

This session is supported by the International Society Of Photogrammetric Engineering and Remote Sensing (ISPRS) and is associated with the workshop 'Remote Sensing in the Tropics' (Friday, Feb 24th, 14:00). However, this session will

focus on biodiversity and ecosystem functioning and is not limited to contributions using remote sensing approaches.

9 Adaption: ecological and evolutionary aspects

Chair: Hermann Behling

The Earth's environment changed through time. Abiotic and biotic environmental factors such as precipitation, temperature, atmospheric pCO₂, trophic sources, species composition of ecosystems are not stable and species need to adapt to survive. This symposium attempts to cover a variety of topics such as speciation, radiation, phylogeny, palaeobiology, plant ecophysiology. The aim of the symposium is to advance our understanding on adaptation addressing ecological and evolutionary aspects during past and modern times.

10 Diversity in African biomes: BIOTA

Chairs: Bettina Weber & Alexander Gröngröft

The BIOTA AFRICA network includes numerous African and German research projects which use a joint interdisciplinary and integrative approach to analyse the change of biodiversity on the African continent. To allow a maximum of extrapolation potential as well as comparability, most of the investigations are conducted on standardized observatories. Before defining sustainable land-use management strategies, information on the inventories, the spatial and temporal variability, the abiotic and biotic driving factors and the dynamics of change have to be assessed. This symposium will expose the state of research after five years.

11 DFG Research Unit 402: Functionality in a Tropical Mountain Rainforest

Poster only

12 Deforestation, fragmentation and land-use changes

Chair: Marcelo Tabarelli

Habitat loss and fragmentation represent a relatively short-lived stage of broader degradation process from natural ecosystems to human-dominated landscapes. In this context, our decisions as society will decide the fate of millions of species and many of the Earth's life-sustaining mechanisms.

The symposium addresses relevant topics involved in the current human-driven changes faced by terrestrial ecosystems. Particularly welcome are those studies providing general guidelines for biodiversity conservation and natural resources management on both old and new human colonization frontiers.

13 Tropical ecosystems in transition: regeneration processes and conservation strategies

Chair: Jaboury Ghazoul

Forest degradation and fragmentation continue unabated across almost all of the world's tropical forests. Tropical plants are likely to respond differentially to these impacts based on their reproductive traits, which may include aspects of their pollination and seed dispersal systems, as well as seedling establishment and growth. Identifying the causes and patterns of such responses will enhance our ability to firstly predict population level responses in the face of continued degradation, and secondly, manage the restoration of tropical forest ecosystems in secondary forest or abandoned pasture land.

Talks - Abstracts

Ecology and genetics of the grasshopper *Cornops aquaticum* (Acrididae)

Adis, J.¹, Brede, E.G.¹, Capello, S.², Franceschini, M.C.³ & Nunes, A.L.⁴

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²Instituto Nacional de Limnología, SantoTomé, Argentina

³Centro de Ecología Aplicada del Litoral, Corrientes, Argentina

⁴Museu Paraense Emílio Goeldi, Belém, Brazil

This semi-aquatic grasshopper from South America is being considered a potential biological control agent of waterhyacinth in South Africa. Host specificity is known from native populations in floodplains of Argentina and Brazil. Specificity can be suggested through correlation of life history traits with the host. Two such traits that have become apparent are that of life cycle and of instar number in juveniles on *Eichhornia* spp. The use of molecular markers in our study will test for correlations, indicating whether the variation represents phenotypic plasticity, genetically fixed adaptation, or an evolutionary relationship with the host-plant.

T9.2

The plant communities of Kakamega Forest, Kenya – A first description and the role of human impact

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²Institute of Integrated Natural Sciences, Department of Biology, University of Koblenz-Landau, Koblenz, Germany



In Western Kenya the easternmost remnant of the Guineo-Congolian rainforest system in East Africa, Kakamega Forest, is highly degraded and fragmented and is an ideal model to study the anthropogenic influence on the forest inventory and on the composition of the plant communities. Its floristic mixture of species from the former rainforest belt stretching from West over Central Africa to the East Coast and of Afromonante elements is unique for this country. After commercial logging activities in the past, selective logging and further human disturbances like collection of firewood are still present.

During five field phases in the years 2001 to 2004 the structure, distribution and the influencing factors on the plant communities of Kakamega Forest were studied. The analyses of the plant communities followed the criteria of the Braun-Blanquet approach. In 19 study sites scattered all over the forest and in every surrounding fragment 200 relevés were established. The cover of every plant species was estimated by the Londo scale in three vegetation layers. Here we present a first description of the plant communities of Kakamega Forest. In total 17 different vegetation units, 13 plant communities and 4 plantations were described. As a result of human impact, every described community represents a different succession stage. The different forest succession stages can be chronologically ordered by means of historical data. Most of Kakamega Forest consists of middle-aged secondary forest often surrounded by very young secondary forest. A true primary forest could not be found due to massive influence by over-exploitation. The forest develops towards a climax stage, but a comparison with former surveys shows that the regeneration is much slower than expected.

Differences were found between the communities of the north and of the southern fragments which are probably due to the different soils and microclimates. The present study was conducted in the framework of BIOTA-East Africa. Therefore, analyses with data gathered by other BIOTA-East subprojects were possible and will be presented and discussed.

Coordinates of all study sites were taken and digitalised in a geographic information system (GIS) in cooperation with subproject E 02 and visualised in Arc View 3.X. Information about the distribution of Kakamega Forest's plant communities and succession stages were connected with the information about the position of the investigated areas. The survey of the state of the forest based on a computer assisted classification enabled us to carry out long-term monitoring for conservation needs.

This study has been kindly supported by the BMBF, Germany.

T10.5

Spatial variability of soil potassium in a tropical forest in Panama

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Soils play crucial roles in many ecosystem processes especially in the nutrient cycle, where they act as important nutrient source and sink. In the tropics, forming and functioning of soils is not fully understood yet. Many variables interact and contribute to the spatial variability of soil properties. In this study we develop a soil landscape model that quantifies the relationships between environmental variables and soil attributes in order to predict the spatial variability of plant available soil potassium. A design-based, stratified sampling scheme is generated to sample at 108 sites on the 1500 ha comprising Barro Colorado Island, Panama. Stratifying variables are geology, vegetation and topography. Topographic variables are generated from a high resolution digital elevation model with a grid size of 5 m. Samples are taken in 5 depths down to one meter and analyzed for plant available potassium in the laboratory. Classification and regression trees are then adopted to develop models that regionalize the point observations using digital terrain data as explanatory variables. This study is conducted to test if soil landscape modeling is an appropriate technique to predict the spatial variability of plant-available soil potassium in a humid tropical forest in Panama. The results will contribute to our understanding of soil landscape processes in the tropics.

T8.3

The ecological role of Biological Soil Crusts (BSC) and contribution to biodiversity along a transect in South Africa

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The ecological role of Biological Soil Crusts (BSC) and contribution to biodiversity along a transect in South Africa

Biological soil crusts result from an intimate contact between soil particles, cyanobacteria, algae, micro-fungi, lichens, liverworts and mosses in different proportions in the upper few millimetres of the soil. They occur worldwide under arid/semi-arid conditions or wherever an arid microclimate exists. However, BSC were always registered where they occurred as an easily visible part of the soil. The aim of our study was to learn the role of BSC and their natural occurrence, away from selective sampling at sites where one can expect them.

Along the more than 2000 km long BIOTA-South transect (http://www.biota-africa.de/1024/biota_south/structure_south.htm), soil samples were collected in so called observatories (32 selected areas of 1 km²) according to a random operating system and were analysed according to species composition, nitrogen and carbon content including their ¹⁵N/¹⁴N-isotope fractionation, chlorophyll content, biomass and soil grain sizes and composition.

BSC were found in all biomes along the transect, except the Fynbos in the south-western part of Africa. The highest diversity of cyanobacteria was registered for the observatory Quaggafontein/Soebatsfontein in the Succulent Karoo with 17 identified genera and 43 species. In total we found more than 90 taxa of cyanobacteria, 39 of green algae and xanthophyceae algae, 15 lichens, and at least 10 liverworts and mosses. BSC in winter rain area tend to be more dominated by cyanobacteria and their matrix is mainly built by trichal cyanobacteria. Spatial distribution of BSCs in winter rain area is more homogeneous and biomass content is higher than in summer rain area. The biomass found in BSC (expressed as chlorophyll a) varied between 1 and 193 mg/m². It frequently reached or even exceeded that of plankton density in the nearby Atlantic Ocean. Soils were generally nitrogen depleted, whereas the nitrogen content of the BSC itself was considerably increased (3-10 times). In the quartz paved semi-desert of the Knersvlakte, a number of phanerogamic plants were regularly associated with the dense cyanobacterial growth (100 mg Chl a/m²) underneath (= hypolithic) the quartz rocks. Their nitrogen content corresponded well with that of the crusts. First determinations of CO₂-uptake showed positive net photosynthesis of BSC already at the low water content of 0.6 mm precipitation equivalent. For the up scaling process, we developed remote sensing techniques (Landsat 7, hyperspectral data from flights) to determine crust cover rates on a landscape scale. Experimental work on the recovering and turn-over rates of BSC is still in progress.

T10.2

Survival strategies in Central Amazonian populations of the Neotropical millipede *Poratia obliterata* (Diplopoda: Pyrgodesmidae)

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The periodic annual high water of the Amazon River led to numerous adaptations in terrestrial invertebrates inhabiting the adjacent floodplains. The small Neotropical millipede *Poratia obliterata* (Kraus, 1960) can be found in different types of inundation forests (white, black, mixed water) and on never flooded upland plantations in the vicinity of Manaus, Brazil. To verify if the various populations represent specific ecotypes, their life cycle, individual development and behavior were studied.

Animals in the inundation forests take refuge on trees during flooding. The trunk ascent is mainly accomplished by individuals of the last juvenile and subadult stage. These millipedes hide under the bark and get aggregated in groups close to the waterline, possibly avoiding dehydration. In contrast, the specimens on upland plantations dwell in moist plant material without aggregation. The populations on plantation sites show a plurivoltine life cycle, i.e. continuous reproduction, whereas a univoltine life cycle, i.e. lack of offspring during flooding, seems to be characteristic of inundation forest populations. Here, reproduction is obviously inhibited by abiotic/biotic factors or the offspring on tree trunks dies due to desiccation and/or the numerous predatory arthropods. Since reproduction occurred in the laboratory even if animals were kept on bark and at a constant temperature of 24 °C, construction material for egg chambers, supply of essential minerals and lower variations in day and night temperatures do not seem to be critical. Data indicate that one of the limiting factors for the animals on tree trunks might be humidity.

Seasonal vertical migration, aggregation and a univoltine life cycle appear to be adaptive characters of individuals living in inundation forests. Specimens inhabiting flooded and non-flooded sites thus may be considered different ecotypes. Analyses of allozyme variation to examine speciation processes, however, did not support habitat specific genetic adaptation of *P. obliterata* in Central Amazonia. Hence, the alternative life strategy of populations in floodplain areas seems to be a phenotypic response to environmental constraints, indicating ecological plasticity in this species.

T9.1

The South African rust fungus mycobiota: biodiversity, composition and affinity

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At present we know about 420 species of plant parasitic rust fungi (Uredinales, basidiomycetes) occurring in South Africa. Little is known, however, about their distribution, their affiliation to myco-geoelements and the affinity of this mycobiota to the rust fungi of other parts of Africa or even other continents.

We collected rust fungi in the Western and Northern Cape provinces of South Africa. Our results show that the rust mycobiota of this area is only incompletely known as some 20 new species could be described although the region is relatively well investigated. We contributed numerous new reports of already known species for South Africa and we described new parasite-host-combinations.

Several findings are especially interesting as they show relationships between the South African rust mycobiota and those of other continents:

Affinities to the nemoral zone of the northern hemisphere: Several species of rust fungi that clearly originate in the northern hemisphere could also be found in southern Africa (e.g., *Milesina blechni*, *Pucciniastrum agrimoniae*, *Uredinopsis pteridis*). We assume that such species migrated to southern Africa on appropriate hosts via step stones with afro-montane or -alpine vegetation.

Affinities to the southern Asian area of the northern hemisphere: Many rust species or related groups of rust fungi show an area reaching from southern Africa to the Indian subcontinent or even a southern African-Indian disjunction (e.g., *Hemileia*-, *Puccinia*-, *Ravenelia*- and *Uredopeltis* species). Similar examples can also be found among plant parasitic smut fungi (Ustilaginomycota). Such a distribution pattern would roughly correspond to the "Sudano-Zambezian Floristic Region" and the adjacent "Indian Region" in the sense of Takhtajan.

By a preliminary survey, we were able to recognize different other myco-geoelements: a "widespread African element", a "Palaeotropical element", and a "Gondwana-element" consisting of rare examples of rust fungi with disjunct distribution between South America, southern Africa and Australia/New Zealand.

We know that at our present knowledge myco-geographical results must be considered as preliminary though some distribution patterns become clearly visible. We emphasize, therefore, the importance of further fieldwork and data collection on southern African rust fungi to get more reliable information on their distribution and to relate the distribution of the parasites to that of the respective host plants.

T10.3

Land use in arid savannas affects species diversity across trophic levels: Mammalian carnivores and their prey.

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Shrub encroachment due to overgrazing has led to dramatic changes of arid savanna landscape structure worldwide. It is considered to be one of the most threatening forms of rangeland degradation altering plant species composition and abundance. However, possible impacts of shrub encroachment on species diversity at higher trophic levels remain poorly understood. Additionally, indirect effects, such as changes of trophical interactions, are often ignored when trying to understand changes in biodiversity patterns. In this study, conducted in the southern Kalahari, we explored how the diversity of small carnivores and their prey is affected by shrub encroachment. Therefore, we analyzed the relations between the abundance and diversity of small carnivores, the availability of their main prey groups (coleopterans, termites, orthopterans, rodents) and the structural diversity of the landscape (shrub, grass and herb cover). 800 track surveys were conducted to determine species specific carnivore abundance on 20 rangeland habitats that represented a gradient of grazing intensity. Prey availability was surveyed for each study site and related to vegetation cover.

Results clearly show a significant impact of shrub cover on the abundance and diversity of carnivores and their prey. Surprisingly, the diversity of both, carnivores and their prey, showed a hump-shaped response to increasing shrub cover whereas carnivore abundance decreased as expected. Availability of prey groups was affected differently by shrub cover increase. Diversity of carnivores was best predicted by shrub cover ($R^2 > 0.7$, $p < 0.001$) indicating the overriding role of habitat structure as compared to prey availability. We conclude that intermediate shrub cover values enrich structural diversity of savanna landscape and in consequence sustain small carnivore and their prey diversity of arid and semiarid ecosystems.

T10.8

Are tropical plant-animal networks more specialised?

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It has been often debated whether species have a narrower niche in the tropics compared to higher latitudes. The analysis of interaction networks can provide a powerful tool to examine variation in the continuum from extreme specialisation to generalisation. A recently published comparison of 'connectance' in various plant-pollinator networks found a trend towards higher specialisation in tropical habitats. However, 'connectance' or the related 'number of links' are based on binary data only, i.e. interactions are scored as present or absent. Consequently, analyses are highly dependent on the size of the network and sampling effort. We developed a novel method to quantify the degree of specialisation using information about interaction frequencies. This method is scale-invariant and very robust against sampling effort. We analysed interaction data from 33 published and unpublished studies on plant-pollinator, plant-herbivore, plant-seed disperser, plant-ant and hemipteran-ant networks. Across these studies, we find no correlation between latitude and specialisation. Unfortunately only few studies are available with published frequency data. This restricts more meaningful analyses where peculiarities of different studies and systems can be adequately controlled for. We would thus be grateful to anyone who can provide published and unpublished matrices of species interactions with frequency information.

T4.6

Beetle diversity of the lower canopy in natural forest and agroforestry systems in Indonesia

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Due to the ongoing loss of tropical rainforests, the potential role of agroforestry systems for the conservation of tropical arthropod diversity became an important issue. We compared beetle-communities in and adjacent to the Lore Lindu National park, Central Sulawesi, Indonesia, from forest sites with those from three types of cacao-dominated agroforestry systems representing an increase in land-use intensity. We collected the beetles by canopy fogging cacao trees in the agroforests and from similar-sized understorey trees at the natural forest sites. The beetles were sorted to species by experts, specialized taxonomists were consulted internationally. Highest beetle diversity (e.g., Fisher's d) occurred in agroforests shaded by forest remnants. Almost no species were recorded in both the natural forest sites and the agroforestry systems. Feeding guild compositions differed between agroforestry systems with those shaded by forest remnants making biological control most likely. In comparison to monotonous, planted shading trees a diverse stand of planted shading trees did not enhance beetle diversity and conservation of species as found at forest sites. In contrast to expectations, spatial turnover within land-use definitions (β -diversity among sites) was in agroforestry systems as high as in the forests. The high turnover between management types explained over half of the regional diversity, which emphasizes the importance of a landscape perspective in biodiversity management. In conclusion, the poorly studied diversity of canopy fauna in cacao-dominated agroforestry systems is unexpectedly high but is sensitive to the type of management; leaving natural forest trees for shading the cacao can significantly enhance the supported diversity.

T8.1

Nutrient export from a tropical montane forest in Ecuador: role of weathering and biological retention

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The majority of studies on nutrient dynamics of tropical montane rainforests were undertaken at stands with geologically young bedrock, frequently influenced by active volcanism. In such environments, weathering and volcanic ash inputs usually plays a major role for the nutrient supply of the vegetation. Furthermore, N is scarce and P strongly retained. We hypothesized that in TMF on soils developed from geologically older parent materials nutrient supply by weathering and resulting nutrient export is reduced. In addition, we expected a larger risk of P and particularly N losses.

We conducted our research in a forest growing on soils developed from bedrock of paleozoic origin on the east exposed slope of the eastern Cordillera in South Ecuador between 1900 and 2200m a.s.l. We monitored input fluxes to the soil (throughfall, stemflow and litterfall) as well as export fluxes in soil solution at 30cm depth of the mineral soil and via discharge in three microcatchments (8-13 ha), all in weekly resolution over five consecutive years (May 1998 to April 2003).

Soil acted as a sink of N, P and Ca, and as a source K and Mg. S concentrations were highest in mineral soil solutions, probably because of oxidation of sulphides, partly originating of the parent rock (shists). However, SO₄ released in the upper 30cm of the mineral soil was retained in the deeper subsoil, possibly by chemical reduction. Although a considerable N-stock had accumulated, the N cycle was still closed. However, we did not determine gaseous N fluxes. In spite of the lower P-retention capacity of the studied soils as compared with allophone-rich soils from young volcanic rocks, P was kept in the soil-plant compartment. The Ca export, frequently driven by weathering on younger soils had a similar size as the soil input of Ca, indicating that Ca was retained in the biological compartment. Our results demonstrate that the Ca cycle is more closed and thus more strongly controlled by the biosphere than in tropical montane forests on geologically younger parent material. In spite of the high accumulation of N and P in the soil organic layer, export of these elements via river discharge was still low. This suggested that N and P – similar to Ca – mainly cycled between the organic layer and the vegetation. Our findings support the hypothesis that the vegetation in the studied montane forest on geologically old parent material controls a larger part of the cycles of N, P, and Ca than reported in the literature for forests on younger rocks.

T6.6

Trade-offs between flower size and pollination success equalise fitness of coexisting tropical tree species

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Trade-offs that confer differential fitness in contrasting environments may contribute to resource partitioning and the maintenance of species richness in plant communities. They may be important to tropical forest regeneration processes in circumstances where the availability of limiting resources is disrupted by human activity or fragmentation. We investigated the potential trade-off between flower size and pollination success for 11 canopy dipterocarp species growing sympatrically at Sepilok Forest Reserve in Sabah, Malaysia, during 2001 and 2002. Flower production varied between means of a few thousand to a few million across species and correlated negatively with mean flower mass. However, viable fruit production was not significantly related to flower production across species because measures of pollination success (percentage of flowers pollinated and mean number of pollen tubes per pollinated flower) were correlated positively with mean flower mass and negatively with mean flower number. Therefore fruit production, a key determinant of fitness, was uncoupled from flower production in inter-species comparisons. We interpret these findings as evidence supporting the hypothesis that dipterocarps compete for pollinator services during flowering events. Competition for pollinators as a limiting resource may have contributed to differentiation of floral size among species and contribute to the maintenance of species richness in tropical tree communities.

T13.1

Resource supply versus species type: assessing the roles of light availability and species traits in driving productivity of trees in Amazonia

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A continuum of light requirements exists among tree species, with certain species adapted to the extremely low light conditions found under the canopy (shade-tolerant species) and others surviving only in the high light environments found in the centre of large forest gaps (light-demanding species). It has been frequently observed that light-demanding species generally have rapid diameter and height growth rates compared to the more slow growth in size of shade-tolerant species. However, it is not known whether more light demanding species have inherently faster biomass growth rates as adult trees, and to what extent observed variation in both diameter and biomass increment is determined by variation in microclimatic conditions. To address this issue, the light environment of each tree (>10cm dbh), within 8, one hectare permanent forest plots in northern Peru was characterised using a canopy illumination index (CII). The CII consists of an ordinal scale, with the classification chosen through assessing the amount of lateral and vertical light incident on the canopy. Hemispherical photography was used to calibrate the index through calculating the direct, indirect and global site factors associated with each CII index value. Wood density was used as an indicator of shade tolerance, as light-demanding species typically have less dense wood than shade-tolerant species. The relative impacts of resource availability (light availability) and species type (shade-tolerant versus light-demanding) on rates of diameter and biomass increment was assessed. The different patterns of growth between species with different traits may have important implications for overall forest productivity following compositional changes which may occur with climate change or during recovery from deforestation.

T1.4

Growing old in the Amazon: predicting tree mortality from prior performance

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Understanding the mechanisms that determine tree mortality is essential for developing reliable models of tropical forest dynamics. In particular, the extent to which overall tree carbon balance or stochastic disturbance events control tree mortality in different tropical forests is unknown. For example, the ultimate cause of death of a tree that died standing (static death) could be competition for light from surrounding trees. In contrast, catastrophic disturbances cause instantaneous tree death by breaking or uprooting the stems (dynamic death). We applied logistic regression to estimate the best predictors of the mode of tree death, static death and dynamic death, in RAINFOR (Amazon Forest Inventory Network, <http://www.geog.leeds.ac.uk/projects/rainfor/>) permanent sample plots in Northern and Western Amazonia. The mortality models were constructed using indices of tree size, prior growth, and competition, and evaluated using the Hosmer-Lemeshow goodness-of-fit statistic. Our results showed that prior growth performance is a better predictor of static, than dynamic death. Incorporating these relationships into models of forest dynamics, could improve estimates of spatial and temporal variation in tropical forest structure.

T1.7

Choice of hibernacula and its influence on energy expenditure during hibernation in *Cheirogaleus medius*

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Life is costly, especially for endotherms in cold, unproductive environments. It should therefore be expected that endotherms choose conditions where energy expenditure is minimized whenever possible.

The fat-tailed dwarf lemur (*Cheirogaleus medius*) is a small (150 g), nocturnal primate species of western Madagascar. It is unique among primates because it spends seven months hibernating during the cold dry-season, when food and water availability are low. During hibernation this lemur shows a peculiar, very flexible mode of body temperature regulation. The body temperature conforms to the ambient temperature in the tree hole used as hibernaculum, resulting in a wide variety of body temperature patterns, from very stable to highly fluctuating (> 20 °C per day) ones. This in turn, is also reflected in the metabolic rate, and energy expenditure is therefore highly dependent on the insulation properties of the respective tree hole.

Surprisingly, the lemurs retreat in tree holes with very different insulation capacities for hibernation, and there does not seem to be a clearly preferred "type" of tree hole, despite the far-reaching consequences for the pattern of body temperature. The effects of the different kinds of tree hole properties on the energy expenditure during hibernation, and possible advantages and disadvantages will be discussed.

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T9.4

Diet of the Giant Otter (*Pteronura brasiliensis*) in shallow oxbow lakes: causes and consequences.

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We observed the diet and feeding ecology of giant otter (*Pteronura brasiliensis*) in 2 oxbow lakes of the Manú National Park, Peru during 2003, 2004, and 2005. We habituated and observed 2 families of otters, and visually identified all observable prey items during multiple seasons. Our behavioral observations included documentation of the otters' hunting behavior, habitat use, prey capture, and social interactions.

In order to understand changes in the prey base used by the otters, we also conducted periodic sampling of the fish fauna of 4 oxbow lakes, and conducted wet-season sampling of lateral fish migrations between our 2 main study lakes and the Manú River. Fish captured in the migration channels were identified and sampled to determine their reproductive status.

We report on the patterns we observed in seasonal variation in diet and habitat use of *Pteroneura*. We found a marked pattern of switching to smaller prey inhabiting shallow edge habitats during the dry season, and propose that *Pteroneura* families change their hunting strategy during the dry season to accommodate the limited swimming and feeding abilities of newly emerged young.

We also discuss our preliminary findings on lateral fish migrations, which indicate that the majority of fish moving out of our study lakes had not yet spawned, and may be using oxbow lakes primarily as feeding grounds before migrating elsewhere to reproduce.

Finally, we discuss possible trophic interactions imparted by the otters' observed prey choice on the functioning of oxbow lake communities.

T4.4

Crab-human interaction: Implication of life history traits, habitat structure and capture techniques for the sustainability of a mangrove crab fishery in N-Brazil

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The mangrove crab *Ucides cordatus* is heavily exploited in Brazilian mangrove forests, due to its high abundance, large size and nutritional value. Population collapses in many regions caused by habitat destruction, overfishing and/or lethargic crab disease call for sustainable management strategies. Results of socioeconomic and biological field and laboratory studies conducted in the N- Brazilian Caeté estuary since 1997 are reviewed in relation to implication for management. Approx. 40% of the rural coastal population in this area depends upon the *Ucides* fishery for the main part of their income. The present status of the Caeté crab population is evaluated basing upon an 8-year series of fisheries monitoring data and by incorporating central life history features and the relationship between the species and its environment. Current hypotheses concerning recruitment patterns and mechanisms are presented. Growth increment studies indicate that *U. cordatus* is slow growing, which suggests a high vulnerability to overfishing. However, at present there is no evidence that the crab population is endangered by the fishery, despite over 30 years of de facto open access exploitation. Apparently, the selectivity of fishermen and consumers for large crabs as well as habitat structure and local artisanal capture techniques are key factors in preventing a rapid overfishing of the crab population until today. Our results suggest that the economic and social sustainability of this fishery is affected well before the biological one, which needs to be considered for the coastal co-management plan that is currently being developed for the newly established extractive reserve in the study area.

T6.2

Species drought sensitivity shapes local and regional species distribution patterns in tropical forests

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Tropical forests possess the most diverse plant communities on earth, yet the processes dictating tropical species distributions, and thus community composition and diversity, remain poorly understood. The most pervasive patterns of species distributions in tropical forests worldwide, as well as in many non-tropical systems, are regional and continental scale correlations with rainfall, and local scale associations with topographically defined units, which frequently vary in soil water availability. However, factors that co-vary with water availability, namely herbivore and pathogen pressure, and light and nutrient availability, have also been proposed to produce observed patterns. Efforts to distinguish between these potential factors have been hampered by a lack of comparative experimental data on tropical plant species' reactions to relevant axes of environmental variation. Here we use experimental field assessments of drought sensitivity of 48 native trees and shrub species to show that differential drought sensitivity shapes both local species distribution in the 50 ha forest dynamics plot on Barro Colorado Island, and regional species distributions across a rainfall gradient spanning the Isthmus of Panama, assessed in a network of 67 forest dynamics plots. Our results suggest that niche differentiation with respect to water availability is an important determinant of local and regional distributions in tropical forests. Changes in soil moisture availability mediated through global climate change and/or forest fragmentation processes are therefore expected to have a strong impact on species distribution, community diversity and ecosystem function.

T7.5

Does improved seed dispersal service account for increased genetic exchange?

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The genetic structure of plant populations is determined by the counteracting forces of mutation, genetic drift and gene flow via pollen and seeds. Plants with extensive seed dispersal show little or no genetic structure among populations whereas plants with limited seed dispersal show more obvious genetic structure among populations. We studied the frugivore assemblage and seed dispersal service in combination with the genetic structure of *Prunus africana* in Kakamega Forest, western Kenya. Using microsatellite markers we compared adult with seedling populations. This allowed studying changes in gene flow pattern between stage classes as a consequence of human impact. Our results showed that the frugivore assemblage and seed dispersal service were even improved following human impact. However, genetic diversity decreased and consequently genetic differentiation increased from the adult to the seedling stage class indicating somewhat restricted present gene flow caused by human activities. Thus, it is not possible to extrapolate from improved quantitative seed dispersal rates to increase genetic exchange which highlights the importance of combining studies on different diversity levels.

T2.6

Nutritional upgrading by endosymbionts: A solution to the ant-biomass paradox in tropical regions?

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Ants are hyperdominant in tree crowns in tropical rain forests. Recent studies using stable isotopes (Blüthgen et al. 2003) have shown that some arboreal ant species can achieve their abundance by feeding principally as “herbivores” i.e. foraging on homopteran exudates and nectar. Since these food resources are scarce in nitrogen it has been speculated that symbiotic microorganisms of homopterans or ants themselves play a key role in nutritional upgrading. We conducted a comparative study of the gut microflora of several species from 3 different clades of the arboreal ant genus *Tetraponera*. For this genus Billen and Buschinger (2000) have described a gut pouch in 1 clade of *Tetraponera* (*nigra*-group) with the putative function of harbouring bacteria. Species of other clades of the genus lacked such a pouch. For all colonies examined belonging to 4 species of the *nigra*-group we detected a *Bartonella*-like endosymbiont (Rhizobiales) and evidence for coevolution with their hosts. In all examined species lacking the pouch we found prokaryotes that are closely related to endosymbionts of other arthropods, e.g. *Sodalis* (S-endosymbiont of tse-tse flies) or *Enterobacter agglomerans*, a bacterium that is known to fix nitrogen in termites. In several bacteria from all *Tetraponera*-clades we have also found evidence for a nitrogen-fixing function suggesting an important and general role of these gut microorganisms in nutritional upgrading in these arboreal ants. In addition, we will present first results on the function in nutritional upgrading of *Blochmannia*, the obligate intracellular endosymbiont of the species-rich ant genera *Camponotus* and *Polyrhachis*.

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T5.5

The size of primate-dispersed seeds – a comparison between Paleotropics and Neotropics

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Primates represent a major proportion of the arboreal frugivore biomass, both in the New World and Old World tropics. It can thus be expected that they exert a selective influence on the fruits of plant species integrated into their diet. Frugivore body size and the way of seed handling (e.g., swallowing vs. spitting) are factors that may play a role in primate-plant interactions. Here we test the hypothesis that the larger body size of Paleotropical primates results in their handling and dispersal of larger seeds in comparison to Neotropical primates. We compiled data from the literature and from our own research on primate body size and on linear dimensions of dispersed seeds. We calculated the ratio of seed length and width (as a measure of roundedness) and the seed surface area, and applied ANOVA and Multiple Regression Analyses to test our hypothesis. Seeds dispersed by primates in the Paleotropics are on average significantly larger than in the Neotropics; this result holds true if "plant family" is factored into the analyses. There was no difference between Paleotropics and Neotropics in seed roundedness and in the upper limit of the size of dispersed seeds (40 mm length). We conclude that Paleotropical primates select for larger seed sizes compared to New World primates and discuss the reason for similar upper limits.

T2.4

Effect of multiple purpose NTFPs harvest on the reproductive performance of *Khaya senegalensis* (Meliaceae) in Benin, West Africa

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Abstract – As a response to an increasing concern about the sustainability of harvesting non-timber forest products (NTFP) in tropical ecosystems, there is a growing literature on the impact of harvesting plant parts on their population dynamics and ecosystems health. Although most of the studies focused on palms, they investigated the effect of harvesting not more than one type of NTFP. This study assessed the ecological impact of multiple organs harvest (bark and foliage) by indigenous people, on *Khaya senegalensis* in Benin. The bark of this overharvested tree is used as a medicine for malaria; the leaves are pruned as a critical dry season source of fodder for *Fulani's* livestock and the timber is highly prized. Using a combination of the percent branch pruned, the number of year since last pruning and the percent bark removed, twelve populations were surveyed and categorized into two harvesting intensities groups within two contrasting ecological zones. Data were collected on fruit and seed production, diameter at breast height (dbh), heights and other morphological traits. The minimum fruiting dbh was 20 cm although most trees fruit around 40 cm dbh. The study discussed how harvesting bark and foliage affects the number of fruits per tree, the average size of fruit, the number of seeds per fruit and the average size of seed across different environmental gradients in Benin.

T6.3

Rainfall redistribution in a palm-rich open tropical rainforest

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The uneven throughfall-input to the forest floor controls differences in nutrient inputs and small-scale soil moisture. In order to examine temporal patterns of throughfall spatial variability, throughfall volumes and incident rainfall were measured during the rainy season of 2004/2005 for individual rain events of differing intensities and magnitudes in a palm-rich open tropical rainforest in Rondônia, Brazil. Additionally, estimated interception losses were compared to modeled interception losses obtained by applying the revised Gash model in order to identify sources of throughfall variability in open tropical rainforests.

Gross precipitation of 97 events amounted to 1309 mm, 89 +/- 5.6 % (S.E.) of which reached the forest floor as throughfall. The redistribution of water within the canopy was highly variable in time, which we attribute to the high density of babassu palms (*Orbignya phalerata*), their seasonal leaf growth, and their conducive morphology. We identified a 10-minute rainfall intensity threshold of 30 mm h⁻¹ above which estimated interception losses were highly variable. The irregular interception losses result from throughfall variability, which was amplified by funneling and shading effects of palms. This interaction between a rainfall variable and vegetation characteristics is relevant for understanding the hydrology of all ecosystems with a high palm density. As the babassu palm is of great importance as a pioneer species this might be of particular importance in abandoned pastures.

T8.4

Susceptibilities of plants to reproductive decline through changing land use

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Forest degradation and fragmentation continue unabated across almost all of the world's tropical forests. Tropical plants are likely to respond differentially to these impacts based on their reproductive traits, which may include aspects of their pollination and seed dispersal systems, as well as seedling establishment and growth. Identifying the causes and patterns of such responses will enhance our ability to firstly predict population level responses in the face of continued degradation, and secondly, manage the restoration of tropical forest ecosystems in secondary forest or abandoned pasture land.

T13.3

Patterns of tadpole communities in a western Madagascan dry forest

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It remains one of the most intriguing questions in community ecology, how species communities are organized. Studies classifying communities as being either deterministic or stochastic are influenced not only by the organismic group and taxonomic level, but also by the spatial scale considered. Accordingly, patterns observed on a local scale might deviate from those observed on a regional or global scale. In some systems, the refinement needs to be even more elaborate, for example when the habitat in question is separated into two or more subtypes, as each of these different habitat types may show particular community patterns.

For breeding anurans, the Kirindy dry forest of western Madagascar represents such a system of subdivided habitat. Breeding takes place either in ephemeral ponds in the closed forest, or in ponds in the bed of a seasonal river. In a field study, we examined the influence of environmental characteristics of these two different, interlocking breeding habitat types on two community parameters, namely species composition and species richness of tadpole communities.

The breeding ponds in the two habitats differed in environmental characteristics, temporal availability, and species composition. When looking at the community patterns, the two habitat types differed strikingly in the predictability of their species composition and of species richness. In the forest ponds, there was a significant correlation between species distribution and environmental characteristics, indicating that sites with similar environmental characteristics had similar species assemblages (environmental response signal). In contrast, for riverbed ponds, there was no such correlation. In neither of the two habitat types was there a correlation between species distribution and geographic distance (no spatial response signal).

We present several hypotheses to explain this phenomenon. Moreover, we emphasize that not only the choice of scale, but also the consideration of different habitat types is important for studies on community ecology.

T7.6

The formation, characteristics and revegetation of bare patches in the Namibian thornbush-savannah with special regards to soil properties

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Within the BIOTA-Southern Africa project, bare patches in the semi-arid thornbush-savanna in the Otjiozondjupa-region, Namibia were investigated. These sparsely to unvegetated patches are a common feature in this area and can reach dimensions from several square meters to hectare-sizes. The development of bare patches is a degradation process that can be most probably linked to poor grazing practices such as overgrazing and trampling which lead to bush-encroachment and a reduction of grass-cover. Mineral and biological soil crusts result from the decrease of grassy plants and enhance the process by hampering infiltration of rainwater in the top soil. Since reduction of life-stock alone does not lead to revegetation, botanical and soil scientific tests and analyses were conducted to I) identify the causes of the decline of soil fertility and II) select various methods of re-establishing vegetation.

During a first research phase, two transects of 5 and 4 study sites with a size of 20 x 50 m each were established along a topographical and soil textural gradient. Composition and abundance of plant species were determined and plant coverage estimated. The soil type and soil chemical and physical properties of the topsoil with a focus on soil crusts were analysed. All data were correlated and interactions/ possible causes of the bareness interdisciplinary evaluated.

In a second research phase, different restoration experiments (four types: ploughing, sowing & bush packing in different combinations) were conducted on selected sites (January 2005). After the treatment botanical and soil scientific data were collected and compared to the properties of the initial state.

Concerning the characterization of the actual state of bare patches it could be shown that

the degree and size of bareness increased with the clay content in the topsoil along the transects, the plant coverage within a 20 x 50 m site decreased with a reduction of infiltration rate, soil chemical properties of the top 10 cm of soil did not show significant differences between bare and well vegetated sites.

First investigations on restored sites showed: an increase of plant coverage, esp. grasses, increased soil surface roughness with a decrease of bulk density on ploughed sites and a tendency of single ring infiltration rate to increase.

T10.1

Towards recovery of dry Andean forest in Colombia: An onset to accelerated natural succession

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Based on the idea of vegetation succession accelerated by canopy closure of planted woody species, a plantation experiment was carried out aiming at restoration dry Andean dwarf forest in the Colombian Andes. Secondary succession in abandoned fields of the area often proceeds too slow or takes a non-desired course due to abiotic or biotic barriers, such as strongly fluctuating soil temperatures and humidity, and a lack of seed dispersal.

The principal research questions of the restoration experiment were:

1. How do planted pioneer- and late-successional woody species perform in open secondary vegetation types and in exotic *Acacia decurrens* plantations?
2. Can natural succession in pastures and scrubs be accelerated by plantation of native woody species?

Plantation with mixtures of pioneer species, and of late-successional species, were applied in pastures and shrublands. Survival after 4 years was low for some species, probably caused by periodical drought and night frost. Seedling growth was generally low: pioneer species reached stem heights up to around 1 m, while the late-successional species mostly did not grow significantly. Pioneer shrubs performed better in pastures than in shrublands. Late-successional species survived better in pastures, but stem growth was higher in shrublands. A canopy of planted seedlings was established only with pioneer species planted in pastures. Changes in species composition were not an effect of the planted canopy. However, total herb cover in these plots did increase as an effect of the plantation. We concluded that succession can possibly be accelerated by a planted canopy, but more time is needed to be able to detect successional changes. It is recommended to use mixtures of pioneer, mid-, and late-successional species in future plantation trials.

The possibilities for conversion of *Acacia decurrens* plantations to native *Condalia* dwarf forest were examined by inserting native late-successional species under the planted canopies. We concluded that underplanting of late-successional *Condalia* dwarf forest species give good prospects for conversion of *Acacia* forests into native vegetation. More experiments are needed to determine after what period of time the *Acacia* canopy should be thinned or cleared.

T13.4

Natural Forest Management in Neotropical Mountain Rain Forests - An Ecological Experiment

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The most common strategy for the conservation of highly diverse ecosystems probably is the establishment of protected areas, but it hardly functions well when it is not accompanied by effective administration and control mechanisms. Another option is reforestation measures to reduce the human pressure on the remaining natural forests. This implies that the performance of the established plantations is not only economically reasonable but also ecologically. The employment of native species could increase the biodiversity, the hydrological and the general stability of plantations, but the propagation techniques for a multitude of species are still unknown. The article focuses on a third complementary strategy for conservation of high diversity forest ecosystems: the sustainable management of natural forests. This strategy could especially be very effective in buffer zones of National Parks with high human pressure but it requires a profound understanding of ecological processes. Liberation techniques of valuable trees are common silvicultural tools worldwide, not only in temperate forests but also in many tropical rain forests. Anyhow, the feasibility of these techniques for tropical mountain rain forests is almost unknown. In this study we analyse the ecological effects of experimental liberation measures on 13 hectares of undisturbed mountain rain forest.

The abundance of valuable timber trees in the study area is relatively high, but the maximum diameters, population structures and growth of many potential crop species have to be considered as rather unfavourable for sustainable forest management. It shall be analysed if liberation techniques can enhance the growth and the natural regeneration of selected potential crop species, and thus improve the preconditions for economically sustainable management systems. In an interdisciplinary approach it is demonstrated if the logging intensity influences selected ecological parameters like structure and diversity of the remnant stand, and the diversity of epiphytes and moths. Furthermore it is studied whether soil respiration or water and nutrient fluxes are significantly affected by the logging intensity. Starting from first results of the experiment, it is discussed if silvicultural treatments can be a tool for sustainable management and conservation of Andean rain forests, and which further socioeconomic and ecological information is necessary for the implementation.

T13.5

From succulents to savanna – A vegetation classification of the Central Namib Desert in Namibia

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For the first time, a detailed vegetation map and phytosociological classification is presented for the Central Namib Desert in Namibia. While descriptions of broad vegetation sequences exist since early past century a phytosociological classification as well as a map with distinct distributions of vegetation units is still lacking. Since 1995 a number of 1200 relevés was documented and classified with multi-factorial analyses. All major habitat types between the Ugab and Kuiseb river in north-south direction, and the Atlantic ocean and savanna in west-east direction, i.e. an area of 140x240 kilometres, are covered by the study.

As a consequence of a broad climate induced pattern of the vegetation composition that is due to fog events restricted to the coast and only occasionally invade far inland or to rainfall events showing an opposite pattern, distributions of species and of vegetation units are predominantly very distinct. Ten alliances could be differentiated which include highly adapted succulent vegetation units of the sand dunes, the beach, salt pans/fens and plains within the intense and wider fog zone near the coast. In the zone of minimal rainfall and fog in the midst of the Namib Desert, plains are characterized by ephemeral vegetation units such as annual *Stipagrostis* species or *Zygophyllum simplex*. On ridges and hill slopes succulent species constitute the vegetation units, being a mixture of leaf- and stem succulents in the fog zone and characterized solely by stem succulents (*Commiphora* spp.) further inland. East of the minimal rainfall zone the Central Namib is characterized by the superior *Boscia foetida* unit that falls into vegetation units that are less closely restricted to a certain habitat. Plain lands are characterized by either small perennial grasses (*Eragrostis nindensis*) or by small perennial half-shrubs (*Zygophyllum cylindrifolium*) on shallow calcareous soils, by stem succulent shrubs such as the large *Euphorbia damarana* shrubs on shallow stony soils or *Calicorema capitata*. At the transition to savanna increasingly thorn shrubs such as *Acacia* species form the vegetation of the plains. They also characterise the vegetation of the washes and small rivers already further towards the coast, while composition of vegetation units here depends on the amount and frequency of ephemeral water inflow. Large ephemeral rivers, dissecting the area from east to west, i.e. the Kuiseb, Swakop, Khan, Omaruru and Ugab, are inhabited by large groundwater fed indigenous tree species or by invading species such as *Nicotiana glauca* or *Ricinus communis*.

T10.4

Assessment and evaluation of plant diversity patterns and species changes in Northern Benin (West Africa) in regard to conservation and sustainable use

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In many West African regions knowledge about phytodiversity patterns and vegetation changes is still very limited. However, these data are crucial for improving conservation measures and sustainable use as well as for evaluating diversity changes in relation to increasing human impact and climatic variability.

By an interdisciplinary approach phytodiversity patterns were documented and analyzed on different scales in the Pehunco area of Northern Benin. Botanical field data are combined with satellite data to provide vegetation and land use maps. In a second step species distributions are modeled using the GARP system, high resolution satellite images and georeferenced species occurrence points to compile diversity maps for evaluation. For a deeper insight in changes of species composition, interviews with local key informants are carried out, focusing also on the consequences of diversity decline for the local population as an important starting point for developing approaches of sustainable use. Additional ethnobotanical data on the use value of plant species serve to compile priority lists of decreasing, socio-economically important species (e.g. for medicine). These data are combined with the results of the modeling approach for analyzing species distribution patterns with regard to valuating phytodiversity resources. This approach - combining remote sensing and botanical investigations with anthropological research on local perceptions - enables a more detailed assessment of phytodiversity dynamics as well as the evaluation of changes in regard to needs of the local residents. Furthermore, recommendations for protection measures can be derived.

The investigations are part of the BMBF funded BIOTA research network on biodiversity, sustainable use and conservation in Africa.

T10.6

Effects of forest fragmentation on movement patterns of three Mata Atlântica bird species in the State of São Paulo (Brazil)

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The Mata Atlântica, the coastal rainforest of Brazil is one of the world's 25 biodiversity hotspots and amongst them it is the most highly threatened ecosystem. This region is rich in endemic and threatened animal and plant species, but due to urban development and agriculture, only 7-8 percent of the primary forest still remains (Galindo-Leal & De Gusmão Câmara, 2003). The objective of our study is to assess how forest fragmentation and landscape features affect the movements of different Atlantic forest bird species. We conducted the field work in the Atlantic Plateau of São Paulo, Brazil, and worked in eight fragments (3 ha - 53 ha) as well as in a control area – a natural reserve of 10,000 ha. The three study species are the frugivorous Blue Manakin (*Chiroxiphia caudata*, Pipridae), the insectivorous White-Shouldered Fire-Eye (*Pyriglena leucoptera*, Thaminophilidae) and the insectivorous Rufous-Breasted Leaf-Tosser (*Sclerurus scansor*, Furnariidae). *C. caudata* and *P. leucoptera* are supposed to have a medium, *S. scansor* a medium to high susceptibility to fragmentation. All three species are exclusively forest dwelling. We used radio telemetry to get more precise information about movement pattern and home ranges of the birds. Via triangulation daily positions and daily movements of tagged individuals were documented for a period of three to five weeks. Vegetation structure related to individual bird occurrence was analysed to see habitat preferences. We obtained daily locations for periods of at least ten days for 47 individuals of *C. caudata* (25/22), 13 individuals of *P. leucoptera* (7/6) and 19 individuals of *S. scansor*. The birds used areas of 1 to 9 ha (*C. caudata*), 9 to 19 ha (*P. leucoptera*), and 6 to 16 ha (*S. scansor*). Analyses are still in process; the data are evaluated in a landscape context to see, if fragment size, vegetation structure within the fragments, connectivity of the fragments, matrix structure, or forest cover within the landscape have an influence on bird behaviour. Habitat preferences were assessed using Compositional Analysis (Aebischer et al. 1993), it revealed that the three species, even though all being forest dwelling, have different preferences. We carried out a first analysis of daily movement patterns which depicted a significant edge effect.

T6.7

Patterns of fine root mass, production and distribution along a disturbance gradient in a montane tropical forest, Central Sulawesi

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The effect of increasing forest disturbance on fine root systems has been studied in the margin zone of the Lore Lindu National Park, Central Sulawesi. Study objectives were to analyse effects of increasing canopy gaps, which result from forest disturbance, on tree root system size and dynamics and related carbon storage and turnover. Stand totals of fine root biomass (0-50 cm), vertical root distribution patterns and fine root biomass/necromass ratios were measured in four stages of forest conversion (ranging from natural forest with very low impact to intensively managed agroforestry systems with cocoa). These stages represent widely distributed forest use systems in the region. In addition fine root production estimates have been made by sequential soil coring with minimum-maximum calculation and by using the ingrowth core method.

Fine root density showed a similar exponential decrease with soil depth in all profiles regardless of the stage of forest conversion. Thus, canopy gap fraction seems to have only a minor effect on root distribution patterns. However, stand fine root biomass showed a decline along this disturbance gradient from approximately 400 g m^{-2} to about 200 g m^{-2} . Further, fine root production was significantly lower in the disturbed forest compared to the undisturbed forest. Thus, carbon storage in the tree root system is negatively affected by changes in canopy density and structure. We conclude that management and partial conversion of tropical forests has profound effects on the root system and thereby influences the carbon budget of the ecosystem.

T12.9

Climate change and its impact on the cloud forests of Kilimanjaro

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The vanishing glaciers of Kilimanjaro attract broad interest. Less conspicuous but ecologically far more significant is the associated increase of frequency and intensity of fires on the slopes of Kilimanjaro, which lead to a downward shift of the upper forest line by several hundred meters as result of a drier (warmer) climate since the last century. During the last 70 years Kilimanjaro has lost nearly half of its forest cover, in the upper areas caused by fire, on the lower forest border mainly caused by clearing. The loss of 150 km² of cloud forest - the most effective source in the subalpine fog interception zone - caused by fire during the last three decades means a considerable reduction in water yield. In contrast to common belief, global warming does not necessarily cause upward migration of plants and animals. On Kilimanjaro the opposite trend is under way, with consequences more harmful than those due to the loss of the snowy ice cap of Africa's highest mountain.

T1.1, P1.1

On the move: Long-term leaf-cutting ant population dynamics in a tropical forest

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The huge leaf-cutting ant colonies (genus *Atta*) with millions of members are considered long-lived and sessile, however, long-term observations are rare. An 8-year study of all individual colonies of the *A. colombica* population in a tropical moist forest in Central Panama revealed an unexpectedly high nest-turnover rate due to colony movements (25% per year) and an overall decline of the population size of more than 50%. The highly organized and complex social behavior involved in the logistically challenging task of translocating all colony members and their fungus culture into a newly prepared nest was directly followed. Parasitic infections of the mutualistic fungus culture and raids from army ants were identified as possible causes for colony emigrations and colony death, respectively. High nest-turnover rates lead to higher spatial and temporal heterogeneity of the forest and highlight the role of leaf-cutting ants as ecosystem engineers.

T5.3

Viral diversity and the ecology of rabies in Serengeti wild carnivores

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Rabies is normally viewed as a viral disease causing top-down regulation of host populations. In the Serengeti National Park (SNP), Tanzania, two genetically distinct variants of genotype-1-rabies are maintained in wild carnivores (East et al. 2001). A highly virulent rabies strain occurs in the bat-eared fox (*Otocyon megalotis*), other canids and the white-tailed mongoose (*Ichneumia albicauda*). Infected animals show behavioural and neurological abnormalities and die as a result of infection. In contrast, 37% of approximately 5,000 spotted hyenas (*Crocuta crocuta*) in the SNP are exposed to rabies, as demonstrated by significant rabies-specific virus-neutralising antibody titres, and approximately 13% of this population is infected with a benign rabies strain revealed by reverse transcriptase (RT) PCR. Hyenas infected with rabies intermittently excreted rabies in their saliva, however, infection does not reduce survivorship or longevity or cause clinical symptoms. Patterns of seroprevalence mirrored contact rates between members of a social group. Phylogenetic comparison of the Serengeti rabies-isolates with those from Tanzania and elsewhere showed that the Serengeti canid and mongoose isolates were highly similar (2.1% sequence divergence) and were gathered within one cluster of isolates that included those of domestic dogs in Tanzania. In contrast, the hyena isolates differed substantially (8.5% sequence divergence) from Serengeti canid/mongoose isolates and from domestic dogs isolates. The hyena strain was most similar to rabies genotype 1 isolates from Europe and the Middle East.

Between 2003 and 2004, a rabies epidemic swept through the domestic dog population in rural areas close to the northwestern boundary of the SNP. Numerous domestic dogs died or were killed by villagers when they displayed signs of rabies, and the incidence of dogs biting humans and livestock increased significantly. Despite this rabies epidemic in domestic dogs on the borders of the SNP, no cases of symptomatic rabies were observed in hyenas or other carnivores inside the SNP. We consider that high exposure to a non-virulent rabies variant in Serengeti spotted hyenas may have prevented the spread of epidemic virulent rabies from domestic dogs outside the SNP to spotted hyenas inside the Park. Low population densities, limited ranges and patchy distribution of other carnivores within a structured landscape may also be factors that prevented the spread of the virulent rabies epidemic in domestic dogs to wild carnivores in the SNP. These findings have important implications for our understanding of rabies ecology in African ecosystems and conservation management plans to prevent rabies mortality in vulnerable endangered African carnivores.

East ML, Hofer H, Cox JH, Wulle U, Wiik H, Pitra C (2001) Proc. Natl. Acad. Sci. USA 98, 15026 – 15031.

T4.5

High tree diversity means high productivity – comparative studies from two Neotropical forests

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Field research for this study was carried out in a montane forest on the eastern slope of South Ecuadorian Andes and in a Costa Rican premontane forest. On permanent plots of 400 m² situated in altitudes between 1850 and 2450m above sea level (Reserva San Francisco, Ecuador), respectively between 800 and 1200m (Reserva Biológica Alberto Brenes, Costa Rica), all trees with a dbh (diameter at breast height) of 5 cm or more were inventoried. We quantified soil properties (pH, plant nutrients) and monitored radial tree growth (trees with dbh > 10cm) with dendrometer bands over a period of four years.

Most important tree families are the same in both study areas: Lauraceae, Melastomataceae and Rubiaceae. With ordination methods based on tree species composition within the plots forest types were distinguished. These types are not only distinct in species composition, but also in diversity and structural features like tree basal area and radial growth rates. Structure, species composition and regeneration dynamics are closely related to elevation and topography. In both areas, highest species richness is found on lower slopes and in ravines, together with highest basal area and highest growth rates. Tree diversity and basal area increment are correlated with each other and with nutrient supply (Ca, Mg, K and P). Therefore, nutrient supply seems to be the most important factor driving tree diversity and productivity for the two studied forests. Especially at the Ecuadorian site, where small scale edaphic heterogeneity is high the importance of nutrients is easily recognized. At higher elevations with their poorer soils the forest is dominated by a single slow-growing species (*Purdiaea nutans*, Cyrillaceae), whereas the forest of the lower elevations and ravines is more dynamic and diverse in structure and species composition.

T8.5

Impacts of different forest management strategies on structure and dynamics of tropical rain forests

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Understanding the dynamics of disturbed tropical rain forest is an important issue for conservation and sustainable management of these forests. In this paper we analyse the impacts of different logging activities on the structure and dynamics of tropical rain forests using the process and individual-based rain forest models FORMIX3 and FORMIND.

The models describe growth, mortality, recruitment of trees and competition between trees. The calculation of tree growth is based on a carbon balance. The carbon gain of a tree depends on the photo production of its leaves, respiration and other losses. Trees compete for light and space. Dying large trees fall down and create gaps in the forest. Tree species are grouped in plant functional types. Applications of the models to tropical forests in Malaysia and Mexico are presented. Various logging scenarios were analysed assuming different logging cycles, logging methods, cutting limits and logging intensities. We characterise the impacts using criteria like yield, canopy opening and changes in biodiversity of trees. Multicriteria decision analysis was used to evaluate the scenarios. We analyse the trade-off between yield and achieving a desired ecological state of logged forest. The ecological state of the logged forests can only be improved by enlarging the logging cycles and reducing yields. Our study also demonstrates that high cutting limits or low logging intensities cannot compensate for the high damage caused by conventional logging activities.

T1.3

Global change management: a call for a new approach to the conservation and use of natural resources

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Traditionally, applied ecologists perceived that mankind disturbs an equilibrium world. Accordingly, the discipline of conservation was developed in order to preserve a certain status quo of biodiversity. The advancement of ecological sciences has led to a non-equilibrium view of the biosphere. Biodiversity is affected by the impacts of an unstable abiotic environment and enhances the dynamic and unpredictable performance of its subsystems through evolution and multiple interactions. Very recently, a 'brand-new' product of biological evolution, *Homo sapiens*, has become a major global environmental force – a fact that stimulated the Nobel prize winner Paul Crutzen to declare the beginning of a new geological epoch: the Anthropocene. As documented by substantial studies such as the Millennium Ecosystem Assessment, this new ecological force currently leads to maybe unprecedented rates of global environmental change. The acknowledgement of both, the non-equilibrium character of the biosphere and the existence of very rapid global environmental change, implies that we might need new definitions of and concepts for biodiversity conservation and sustainable resource management. We come to an end of the historicizing equilibrium conservation and natural resource management. Instead we must target the maintenance of changeability and resilience of functional ecosystems. Additionally, we must develop realistic human-driven change scenarios in order to formulate new visions and general principles of natural resource management. We need a strategic design and guidance of projects and institutions to stop or at least slow down the loss of natural resources availability caused by global change. While traditional natural resource management (including biodiversity conservation) focused on reactive abatement of change and restoration of past conditions, *global change managers* will emphasize proactive mitigation and adaptation as key strategies. In this context, many new research and education needs for further development of tropical ecology are arising. Moreover, the required paradigm shift has immediate consequences for current conservation policy and action. Among others, the new approach questions the mainstream methodologies of conservation priority setting, such as the 'Hot spots' approach.

T1.5

Decomposition of two litter types (*Purdiaea nutans*, *Graffenrieda emarginata*) in a tropical montane rain forest in southern Ecuador

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The decomposition of two leaf litter types (*Graffenrieda emarginata*, *Purdiaea nutans* and a mixture of both) was investigated in a tropical montane rain forest in southern Ecuador at two altitudes (1850 m and 2270 m) in a litter bag field experiment. For the litter bags a mesh size of 1 mm was used and, in addition, a mesh size of 48 µm was used to exclude the soil mesofauna. The mass loss, content of C, N, basal respiration, microbial biomass and the colonisation with microarthropods were analyzed after 2, 6 and 12 months exposure in the field. The experiment started in February 2004.

Compared with tropical lowland litter materials decomposition rates were low. Both litter types decomposed slowly (average of 68.5 % remaining material after 12 months) and *P. nutans* litter decomposed slower than *G. emarginata* and mixed litter (ANOVA: $F_{2,108} = 15.59$, $p < 0.0001$). Both litter types decomposed faster at 1850 m than at 2270 m (60 % and 76 % material remaining, respectively). The most abundant microarthropods in both litter types were oribatid mites followed by Collembola, Gamasida, Uropodina, Prostigmata and Astigmata. All animal taxa were more abundant at 1850 m. We found 37 species of oribatid mites. The oribatid mite community was dominated by *Scheloribates* sp., *Pergalumna sura* and *Truncozetes sturmi*. The basal respiration rate in both litter materials was very high (about four to five times higher than in the L/F-horizon of a beech forest in Germany). Basal respiration and microbial biomass were significantly affected by time of exposure, altitude and litter type. At the lower altitude the respiration and microbial biomass were higher than at the higher altitude. Our results indicate that microorganisms respire more in *P. nutans* material than in litter from *G. emarginata* and in a mixture of both materials. However, the microbial biomass data indicate that the conditions to grow are more difficult in *P. nutans* than in *G. emarginata* litter. Soil microarthropods contributed little to decomposition processes indicating that the soil microfauna, i.e. mainly amoebae and nematodes, may be more important for decomposition processes.

T1.8

Advertisement and demand: what plants want and what frugivores make out of it

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Animal-plant interactions continue to be among the most fascinating phenomena in ecology, in particular given the current loss in biodiversity and the question how this may affect crucial ecosystem services such as pollination and seed dispersal. Plants have developed intricate mechanisms over evolutionary times that ensure attraction of pollinators and frugivores. In most cases, the animals are rewarded and carry in return pollen or seeds away from the parent plant. Depending on the animals' behavior, propagation of genetic material leads to successful recruitment of plants in space and time. In my talk, I have selected fruit-eating bats (Chiroptera) as an example for a species-rich and diverse group of highly mobile seed dispersers and discuss their relations and interactions with selected groups of plants that are either of ecological interest in terms of regeneration phenomena and/or that bear economic values for local people. I review current literature combined with ongoing research of our group in the Old and New world tropics to elucidate on one hand the plants' perspective how to attract frugivores and on the other hand the bats' perspective of what they want to get out of fruits and how they handle them. One of my goals is to show how specific behavioral patterns lead to successful recruitment and distinct spatial patterns of selected plants. Special attention is given to fruit characteristics that foster detection and removal by fruit-eating bats and to the spatial patterns of seed dispersal created by the bats. Specifically, I ask where seeds are likely to "land" after they have been carried away and processed by fruit-eating bats and how this is likely to affect the plants' distribution and diversity. Finally, I compare bat dispersal with other dispersal agents among vertebrates and speculate how the current shift in distribution of the flora and fauna due to global climate change is likely to lead to distinct changes in the dynamics of those interactions.

T2.2

Diversity of pteridophytes along an elevational gradient in Costa Rica

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We studied the elevational distribution of the species richness of pteridophytes along an elevational gradient between 100 m and 3400 m in Costa Rica, in relation to climatic variables (temperature, air humidity), regional species pool, regional area, and estimated species numbers due to a model of the mid-domain-effect (MDE). A total of 156 plots of 20 x 20 m were analyzed, while temperature and air humidity were measured at four elevations from Aug. 2002 to Nov. 2003 using 27 Hobo data-logger. Bryophyte cover on trunks and branches was estimated on every plot as a proxy for air humidity.

Species richness showed a hump shaped pattern with richness peak at mid-elevations (1700 m). The peak was more pronounced for epiphytes than terrestrials. Regression analyses showed a close relationship of species richness to MDE, regional species pool, and bryophyte cover, while rainfall, temperature, and area had very low and insignificant relations. Combining the variables to models within multiple regressions revealed the high explanatory power of MDE. However, a comparison with other transect studies suggests that the correlation to MDE may be spurious. Excluding MDE from further regressions, any model including temperature, bryophyte cover, and rainfall reached regression values close to MDE alone.

Pteridophytes are strongly humidity-dependent organisms, and therefore the peak of diversity could reflect optimal humidity and temperature conditions. Since rainfall and, especially, temperature alone had weak relations to species richness, there is evidence suggesting that they operate in different ways on different parts of the gradient. Dividing the transect at 1700 m revealed the strong contribution of temperature to the control of species distribution along the whole gradient. Therefore we assume that temperature and humidity are the most basic climatic variables limiting species richness at both extremes of the gradient: At low elevations high precipitation is to a certain degree offset by high temperatures, leading to reduced air humidity with periodic dry periods, even in the wet season. At high elevations decreasing precipitation and exposition to strong winds above the condensation belt increases drought stress for the plants, and low temperatures and especially frost events contribute to unfavorable growing conditions.

T7.4

The BIOCAPSP Project: Research for Biodiversity Conservation in fragmented Landscapes at the Atlantic Plateau of Sao Paulo, Brazil

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The objective of the ongoing project is to investigate the causes and consequences of forest fragmentation on the biodiversity of the Atlantic forests in order to provide ecological and socio- economical sustainable guidelines for the conservation and use of natural resources in a highly threatened biome of Brazil.

As a consequence of inefficient politic, local land tenure and socio-economical divergent conditions natural Mata Atlântica forest remnants still experience a high pressure of anthropogenic degradation. However they still represent long term oriented direct, indirect and existential use values for the vast majority of the local human population. Anyway the current intensive agriculture practices turned out not to be adapted to local soil conditions, to be too cost intensive and highly soil degrading.

A simulation of the forests regeneration potential indicates that in smaller remnants the biomass gain after 300 years stays far behind the biomass gain in natural continuous forests.

As several representatives of different groups of organisms (small mammals, birds, amphibians) exhibit typical micro habitat preferences, many species seem to be affected by fragmentation rather by its consequences on forest structure and resource availability than by the size of the fragments. Additionally small fragments exhibit very high population dynamics comparing consecutive years thus making even temporarily small populations more vulnerable to stochastic events. These high population dynamics need to be considered in selection procedures of suitable sites that are planned to be integrated into a network of priority sites for conservation. The most suitable methods for the selection of priority sites for conservation integrate the selection and combination of more sensitive responding surrogate species out of different taxonomical groups. Using these combinations of surrogate species from different groups the highest number of animal species may be maintained in a network of priority conservation sites in a long term run.

The BIOCAPSP project intends to extend the studies analyzing the landscape temporal dynamics and the importance of the matrix in this region, as well as to expand the project to other areas of the Atlantic Plateau of Sao Paulo in order to address new questions. Besides testing if the results obtained so far can be generalized, from an applied perspective the project will indicate priority areas for conservation and restoration using the potential distribution of sensitive species in the Atlantic Plateau of Sao Paulo.

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T12.2

Diversity islands in the savanna: termite mounds, microhabitats of special relevance

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Fungus-cultivating termites (Macrotermitinae) are key components of African savannas that deserve the label 'ecosystem engineers' due to their fundamental role in the regulation of ecosystem processes and the maintenance of biodiversity. Mounds of termite *Macrotermes bellicosus* are widespread in West African Savannas. Dead mounds are colonized by various plant species, building often small woody islands in open savannas. For the West African Sudanian zone very few data exist on the plant communities occurring on old termite mounds and their spatial distribution.

In an interdisciplinary approach the spatial termite mound patterns in relation to soil-vegetation complexes and the plant species composition of termite mounds were analyzed. For the spatial distribution the termite mound occurrence was inventoried in ha-plots along 5 to 15 km transects and by GPS mapping of single mounds. In a second step distribution patterns were modeled using the GARP (Genetic Algorithm of Rule set Production) system, high resolution satellite images and the georeferenced species occurrence points. A comparison between patterns in protected areas and adjacent settlement areas provides information on the impact of human activities on termite distribution. Botanical inventories were undertaken on termite mounds and the adjacent savannas.

It was shown that termites play a considerable role for the plant diversity and vegetation structure in savannas. A specific termite mound vegetation revealed with more than 20 woody species. No distinct linkage was found between the termite mound vegetation and those in the surrounding savanna. The spatial patterns of termite mounds were related to different savanna-soil-complexes, such as the *Pterocarpus erinaceus*-savanna on medium soils or the lateritic crust-related *Detarium microcarpum* savanna. In the settlement areas the abundance of termite mounds was comparably low which might have important ecological and socio-economical consequences as will be discussed.

T5.2

Lima bean neighbourhood watch – Herbivore-induced volatiles induce an indirect defence in neighbouring plants

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Many plant species are known to respond to herbivore damage with an increased emission of volatile organic compounds that attract carnivorous arthropods and thereby function as an indirect defence. Whether also neighbouring plants 'eavesdrop' on these airborne signals and tailor their defences accordingly has been debated intensively during the last years, yet evidence for the support of such a plant-plant-communication hypothesis is accumulating. An increasing number of studies suggest that plants can perceive volatile signals as evidenced by transcriptional changes of defence-related genes and respond with changes on the level of phytohormone or defence-related metabolites. However, evidence from field studies on such an information exchange via 'infochemicals' is scarce. We used wild growing Lima bean plants (*Phaseolus lunatus*) to investigate whether herbivore-induced volatiles induce another indirect defence strategy, i.e. the secretion of extrafloral nectar (EFN) in conspecific plant neighbors, and whether this has defensive effects under natural conditions. EFN secretion was induced by volatiles released from herbivore-damaged bean tendrils as well as by an artificial volatile blend resembling the naturally released blend. One constituent of the herbivore-induced blend, namely the green leaf volatile (Z)-3-hexenyl-acetate, was identified as eliciting the observed defence reaction. A long-term experiment conducted to compare the defensive effect of EFN alone with the effect mediated by volatiles (EFN induction plus attraction of plant defenders) indicated, that Lima beans benefit of both indirect defenses. Tendrils that had been repeatedly treated with an artificial blend of either volatiles or EFN performed similarly in terms of fitness-relevant plant parameters and attracted equal numbers of putative plant defenders. To our knowledge, these results represent the first report on an induction of an indirect herbivore defence by herbivore-induced volatiles. The elucidation of this new mechanism opens up new avenues for further studies, ranging from the underlying signaling cascades to the ecological relevance in other study systems.

T4.2

Higher fruit production of a secondary rainforest tree at the forest edge – what does it depend on?

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Tapirira guianensis Aubl. is one of the most frequent tree species in the Atlantic rainforest fragments of the state of Pernambuco (Brazil). It is often cited as a secondary forest tree that profits from forest fragmentation, but it is not clear whether there is a difference in the fruit production between forest border and interior individuals or not.

To quantify the fruit production of the female trees, in 2005 we installed five seed collectors under the crown of each 16 interior and 19 border trees with a DBH of > 20 cm chosen by chance in a 300 ha forest fragment (Mata de Piedade, S 7° 50.25', W 35° 0.00', municipality of Igarassú). After flowering, every two weeks the contents of the collectors were dried, weighed, counted and checked for vertebrate predation traces. Additionally, the tree dimensions (DBH, height, crown projection and crown volume) were measured and the flower number before fructification estimated. During and after seed germination, seedling numbers in plots neighbouring the collectors were monitored.

We registered a significant higher stem diameter, crown volume, flower number and a lower height in the border trees. In terms of fruit production, the weight of single fruits was the same in both habitats, and total number and mass of fruits accumulated per m² and seedling per m² were not significant higher at the forest edge. Considering, however, the higher crown volume of the edge individuals, there was a higher accumulated number (100,478 vs. 66,374; p=0.04; M-W-U=90), a higher accumulated mass (13,381 g vs. 8,009 g; p=0.0314; M-W-U=87) of fruits and a higher number of seedlings (2,430 vs. 917; p=0.0382; t=2.159) per edge tree individual. Additionally, the rate of fruit predation was significantly higher in the interior, which is an indication also of higher fruit removing rates by primary dispersers.

In 2005, *Tapirira guianensis* appeared less favored by edge effects than in 2004. A possible reason may be the prolonged dry period in 2005, which caused the formation of a high number of flowers in both habitats, when compared with the shorter and more humid dry period in 2004, when in phenological observations flowers were detected to form almost only at the edge. To better clarify the role of *Tapirira guianensis* as a pioneer or secondary forest species, studies have to be extended over several years.

Research was carried out within the project „Disturbance, fragmentation, and regeneration of the Atlantic rainforest in the northeastern Brazilian state of Pernambuco“ financed by BMBF (Project No.01 LB 0203) as part of the Mata Atlântica program.

T12.8

Does size matter? - The significance of geographic range size for the perception of large-scale patterns of species richness

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Geographic ranges of species are a basic unit of macroecology and biogeography. It has been documented that range size differs by up to 12 orders of magnitude among species. However, the contribution of widespread and range-restricted species in biodiversity mapping and in macroecological analyses is not well understood. We examined the effect of range size using continental distribution data for all 550 Neotropical palm species (Arecaceae) at varying grain sizes from 0.5° to 5°. First, we evaluated the relative contribution of range-restricted and widespread species to patterns of species richness and endemism. Second, we analysed the impact of range size on the predictive value of commonly used predictor variables. Species sequences were produced arranging species according to their range size in ascending, descending, and random order. Correlations between the cumulative species richness patterns of these sequences and environmental predictors were performed in order to analyse the effect of range size. Despite the high proportion of rare species, patterns of species richness were found to be dominated by a minority of widespread species. Climatic factors related to energy and water availability and productivity accounted for much of the spatial variation of species richness of all species and of widespread species. In contrast, species richness of range-restricted species was to a larger extent determined by topographical complexity. However, this effect was much more difficult to detect due to the dominant influence of widespread species. Although the strength of different environmental predictors changed with spatial scale, the general patterns and trends proved to be relatively stable at the examined grain sizes. Our results highlight the difficulties to approximate causal explanations for the occurrence of a majority of species and to distinguish between contemporary climatic factors and history. These findings have far-reaching implications for conservation and macroecology.

T7.1

Birds as mobile links between intact and degraded areas: the example of Andean rain forests in Cochabamba, Bolivia

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Our study area, Carrasco National Park (NP) on the humid eastern slope of the Bolivian Andes, exemplifies how conflicting land-uses can lead to conservation problems not only outside, but even within the boundaries of comparatively well-protected areas. A field study of the movements of the local avifauna, the first ever undertaken in the Andes covering all altitudinal vegetation zones (300-3,500m), reveals that an important part of the avian community (and presumably also of other animal taxa) migrates altitudinally in both directions (uphill as well as downhill) after breeding. The NP, which is famous especially for its vast and intact humid forests covering the complete altitudinal gradient from the Amazon lowlands up to the treeline, is surrounded by densely populated areas that have already undergone medium to critical deforestation. While the adjacent highlands have been under anthropogenic pressure for hundreds of years, the lowland forests, facilitated by the construction of a paved highway, have been replaced quite recently by a variety of human land-uses, the cultivation of coca for the global drug market being the most prominent one. I.e., various avian populations (or parts of them) leave the park temporarily, pouring into its severely degraded surroundings. Thus, on the one hand, the NP fails in its principal target, namely to protect the entire life community comprised within, because the persistence of a considerable number of avian populations cannot be secured even if the integrity of the park itself can be maintained in the future. On the other hand, as birds play an important role in the ecosystems, e.g. as seed dispersal agents, reductions and local extinctions of bird populations negatively affect ecosystem processes on both sides of the park boundary. This is particularly alarming in face of expected climate change and its potential impacts related to the disruption of biological communities, emphasizing the importance of dispersal systems for maintaining connectivity on the landscape scale. In conclusion, bird communities themselves are affected by events both in protected and adjacent unprotected spheres. As "mobile links", they connect these spheres, providing positive feedback between them, which can result in mutual aggravation of either conservation status. We contrast the implications for conservation strategies and actions with the current land-uses and corresponding future scenarios. General guidelines as well as specific recommendations for land-use management are given which serve to mitigate the conflicts of conservation vs. economical benefit-driven activities.

T12.10

Fungi versus fungi: a critical defense mechanism of the host plant

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Plants are not just green, but a mosaic of plant and fungal tissues. Arbuscular mycorrhizal fungi (AMF) occupy roots and the leaves are filled with a diverse community of foliar endophytic fungi (FEF). Despite the growing recognition of their wide distribution across plant taxa, FEF and their ecological roles are poorly understood. Endophytes cause no apparent harm to their host, however our recent work has shown that some species can defend the host against common fungal pathogens, like *Phytophthora*. The role of a diverse fungal community as a rapidly evolving immune system is theoretically intriguing. In order to understand the direct costs of the mutualism, we created paired combinations of leaves in a single host (*Theobroma cacao*: cocoa tree) with and without their FEF and examined the process of photosynthesis. Our results demonstrate that carbon assimilation was reduced by the presence of FEF. Nothing is known about the additional carbon costs of the FEF themselves.

Considerably more work has been done with AMF and we know that the fungi demand 10-20% of the host carbon in return for many clear growth benefits. Their role in aboveground defense, however, is less clear and varies from positive to negative among various studies. Using the same host species, we tested the potential of *T. cacao* to resist foliar pathogen attack with and without its mutualistic root fungi. Plants without AMF lost 90% of the leaves inoculated with *Phytophthora* after only 2 weeks. Plants with AMF lost less than 15% of their leaves and the damage was often locally contained.

Our results demonstrate that both FEF and AMF can dramatically improve host resistance to pathogen attack. Given the universal love of chocolate, this work is not only ecologically important, but has applied significance as well. Nothing is known in terms of the interactive effects of these two distinct mutualisms. We are in the process of examining factorial combinations of the two symbiotic fungal types within a single host. The fungal mutualists are spatially separated, providing pathogen resistance via direct and indirect methods. The results are discussed in terms of the distribution of costs and benefits between two distinct mutualisms within a single host.

T3.2

Coexistence of three species of *Cheirogaleidae* in a littoral forest in South-East Madagascar

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Madagascar is known for its extraordinary diversity of lemur species. Mechanisms that allow the coexistences of these species are still poorly unknown. Morphological, ecological and behavioural factors which might contribute to avoid competition were studied for three species of *Cheirogaleidae* (*Microcebus murinus* [body mass: 70g], *Cheirogaleus medius* [body mass: 180g] and *Cheirogaleus major* [body mass 360g]) in a littoral forest in southeast Madagascar. During my study in three rainy seasons I compared home range sizes, feeding behavior and sleeping site selection of these three lemur species.

All three species used tree holes for sleeping, sometimes in the same trees. Home ranges did overlap completely, but showed differences in sizes: the home range of the small lemur was smaller than home ranges of bigger lemurs. All species preferred fruits for feeding. There were no differences in morphological or biochemical fruit parameters between the species. Differences were found in the vertical dimension of forest use. *Cheirogaleus major* used upper part of the trees for feeding, resting, sleeping and traveling. *Cheirogaleus medius* used the middle part of trees and *Microcebus murinus* the lower parts.

T9.3

From fungus to human resource use: the conservation implications of primates as seed dispersers

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Primates are more endangered than ever. In the most recent IUCN/Species Survival Commission report, more primate species went into the Endangered or Critically Endangered (CR) categories than ever before (Mittermeier, et al., 2005). Yet, this loss extends beyond the animals themselves; indeed, declines in primate populations have been demonstrated to have measurable consequences for plant population genetics and structure as well as seed and seedling abundance and richness. In this paper I demonstrate the quantitative and qualitative impact of primates in several interspecific interactions, including plant-animal, fungi-plant-animal, and plant-primate-human, and evaluate the implications of these interspecific processes from a conservation perspective. I present data collected between 1993 and 2002 in the Kibale National Park, Uganda, on: (i) seed dispersal behavior of four monkey (Cercopithecinae) and one ape (*Pan troglodytes*) species; (ii) seed fate data from the 8 most common tree species in Kibale; (iii) focal tree follows of fruit removal, and; (iv) human use of resources from plants whose seeds are primate-dispersed. Results from focal trees follows (*Ficus exasperata*, *Uvariopsis congensis*, *Celtis durandii*) indicate that primates remove more fruit ($p < 0.01$) than any other taxon (e.g., birds, squirrels) as a consequence of greater frequency and duration of visitation. Although there is interspecific variability, in general, seed fate data indicate that seeds are more ($p < 0.05$) likely to germinate and survive after having been processed by a primate, and are more likely ($p < 0.05$) to arrive to sites suitable for recruitment. Seed-cleaning of some tree species (*Strychnos mitis*) by monkey oral processing had a dramatic influence ($p < 0.01$) on fungal pathogen attack, similar to what has been described of ant seed-cleaning in the Neotropics (Oliveira et al., 1995). Moreover, I demonstrate that 37% (77/216) of Kibale plant species whose seeds are dispersed by primates are of economical and cultural value to humans living around the National Park. These data illustrate the complexity of fungal/plant/animal interactions and indicate links not only among forest species, but also between sets of plants/dispersers and the human populations that rely on forest, forest edge, and forest fragment habitats. The conservation of primates is a critically important goal in itself, but in working to ensure their protection, we indirectly protect key interspecific processes that have direct implications for human livelihoods.

T2.5

Biodiversity indicators: a new approach from ant studies in Brazil

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With the increasing loss of habitat and biodiversity around the world, there is an urgent need for biodiversity assessment to be carried out during the conservation planning process. One approach used is identifying taxonomic groups whose diversity is related to diversity of other taxa, and therefore can be used as an indicator of the overall diversity of an area. In order to verify the use of ants as biodiversity indicators, I compared scores of ant richness from two ecosystems in Northeast Brazil, Caatinga and Atlantic forest, to those found in other groups of plants and animals. The ant fauna from Caatinga was relatively poor, only 72 species were recorded, lacking groups with more specialized habits such as leaf-cutting ants, army ants, and specialist predators (e.g. *Basicerotini* and *Dacetoniini* spp.). The richest genera were *Pheidole* (10 species), *Solenopsis* (9), and *Camponotus* (8). Ant richness was different between landscape types, with flatlands presenting higher scores than canyons, ravines and hills. Ant richness was positively correlated with the richness of all other taxonomic groups tested (i.e. woody plants, beetles, and spiders). In the Atlantic forest we recorded 176 ant species. The richest genera were *Pheidole* (31 species), *Hypoponera* (18), and *Solenopsis* (10). Ant richness was positively correlated with the richness of pteridophytes, birds, rodents and non-flying mammals, and was also related to the area of forest fragments. However, correlations among ant richness and the richness of bryophytes, trees, and euglossine bees were not significant. The lack of relationship between ants and trees is probably because tree assemblages have been changed by selective logging in this ecosystem. Therefore, they are influenced much more by the historical use of the fragment than its size or other landscape parameters. Our results confirm that ants are good biodiversity indicators in two very different ecosystems of Northeast Brazil. There are still few studies which demonstrated the suitability of bioindicator taxa in Brazilian ecosystems, but its use to identify priority areas for conservation may save time, money and some species of extinction. The challenge now is to increase our knowledge about taxonomy, general biology and ecological requirements of ants to interpret their occurrence in more detail and increase their value as bioindicator taxa.

T5.6

Biogeography and ecology of the Pteridophytes in the Reserva Biológica San Francisco (Ecuador, Prov. Zamora-Chinche)

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The Reserva Biológica San Francisco (RBSF) encompasses moist montane forest, windswept subpáramos, and atypical ridge top vegetation dominated by the otherwise rare tree *Purdiaea nutans*. So far 250 species of ferns and fern allies from 22 families have been recorded here; but as our work focused on the ridge top vegetation at 2400-2660 m, there may still be overlooked species on the slopes and in the gorges. During this study, several new records for the country were made, and six species were new to science.

In order to determine if the ridge top forest at the RBSF represents a special habitat, we compared the fern community on stunted ridge forests and adjacent taller slope forests at three sites in Podocarpus National Park. This vegetation analysis was supported by the assessment of soil components and nutrient contents as well as surveys of macro- and microclimate. Our hypothesis was that the ridge forest is poorer in nutrients and has more extreme climatic conditions than the slopes and that thus species adapted to cope with these conditions dominate the vegetation, such as epiphytic ferns or those associated with mycorrhizal fungi. The biogeographical analysis emphasises the role of the research area as a zone of contact and exchange of species. The results show that most species follow common distribution patterns which overlap in the so called Amotape-Huancabamba in southern Ecuador and northern Peru. Compared to the total number, the quota of recorded endemics is low, and most may be confined to the Amotape-Huancabamba region and not solely to Ecuador.

T8.6

Impacts of livestock grazing on insect diversity and pollination of plants in Namaqualand, South Africa

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Livestock grazing is considered to be one of the main threats to biodiversity (Davis and Heywood 1994), especially in Namaqualand, the north western part of the Succulent Karoo in South Africa, where stocking rates in communally managed areas often exceed the recommendations stated by the government (Hoffman et al. 1999). The presented study investigates the influence of heavy grazing on flower production of individual plants (family Aizoaceae) and general flower occurrence, the effect on pollinator diversity and abundance as well as the consequences for plant recruitment as measured with fruit and seed production. A clear trend towards reduced overall flower production as well as that of individual plants could be reported in degraded areas. Insect diversity and abundance was lower when recorded with Malaise traps and transect counts. Colour trapping, however, mostly resulted in no differences between heavily and slightly grazed sites. The factors that bias the outcomes of colour trapping are plant cover and height as well as flower numbers and flower display area. Fruit setting was limited for plants growing under intense grazing pressure in two out of three years of study. A drought in 2003 led to assimilation of results. Seed production, on the other hand, was equal for most investigated species. Experiments on the reproductive system revealed that the visit of a single pollinator accounts for ample pollination success. It is therefore concluded, that grazing did not yet reduce pollinator numbers to such an extent that plants suffer pollination deficiencies.

The present study forms part of the botanical subproject (S06) of BIOTA Southern Africa (Biodiversity Monitoring Transect Analysis in Africa, www.biota-africa.org, which is funded by the German Federal Ministry of Education and Research (Bmbf 01LC0024).

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T6.1

***Crematogaster*-*Camponotus* Associations in a Tropical Rain-forest: Mechanisms and Specificity of Interspecific Recognition**

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Associations between *Crematogaster* and *Camponotus* colonies are found worldwide. Several species from both genera frequently use the same trail (trail-sharing), or even share a common nest (parabiosis) without any aggression. In a tropical lowland forest in Sabah/Malaysia, we studied both association types as well as non-associated species of both genera. We were interested in the respective levels of allocolonial and allospecific tolerance between both partners as well as the underlying mechanisms of nestmate recognition. Our focal species were *Camponotus rufifemur*, which lives in a parabioc association with *Crematogaster modiglianii*; *Camponotus (Colobopsis) sp.1*, which shares trails with *Crematogaster coriaria*, and several non-associated species of both genera.

In behavioural tests, these ants were confronted with living or dead individuals from different colonies or species or their extracts. Many of the associated species showed surprisingly high levels of interspecific tolerance towards the respective other genus. Workers from all parabioc colonies of *Camponotus rufifemur* tolerated all *Crematogaster modiglianii* colonies, whether they were parabioc or not. Their tolerance towards other *Crematogaster* species however varied strongly across the *C. rufifemur* colonies. The trail-sharing *Camponotus (Colobopsis) sp.1* was highly aggressive towards *Crematogaster* species other than the associated one. Non-associated species of both genera were aggressive towards other species, too. Interestingly, different parabioc colonies of *Crematogaster modiglianii* varied strongly in their intraspecific tolerance. We thus found strong intraspecific behavioural differences in both *Camponotus rufifemur* and *Crematogaster modiglianii*.

Confrontations of ants with dead individuals of other species indicated that the behaviour of the ants in most cases plays a minor role in interspecific recognition. Hence, chemical aspects are more likely to trigger recognition. To test this idea, we confronted ants with extracts of postpharyngeal glands (which generally contain the same substances as the body surface) of other ant species. These extracts partly triggered the expected aggressive response. However, in several associated ants the extracts failed to do so, which points towards interesting chemical irregularities in associated ant species.

We frequently observed that *Crematogaster modiglianii* workers mounted living *Camponotus rufifemur* individuals without being displaced. They showed the same behaviour towards dead *C. rufifemur* bodies. Chemical analyses suggest that *Crematogaster* transfers certain chemical compounds to their parabioc *Camponotus* partner. This finding opens up striking questions on the coevolution of associated partners and their possible ecological benefits.

T5.4

Effects of *Hedychium gardnerianum*-invasion (Zingiberaceae) on regeneration dynamics of a montane rainforest on the island of Hawai'i

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Hedychium gardnerianum (Zingiberaceae), a 1 – 2 m tall rhizomatous herb native to India's Himalaya region, was introduced to Hawai'i in 1943. Today, the species is one of the most aggressive weeds in the montane rain forest of the Kilauea area (Hawaii Volcanoes National Park, Island of Hawaii). The purpose of this study is to clarify whether i) *H. gardnerianum* replaces native understorey species, ii) is altering conditions required for germination and seedlings establishment, iii) is suppressing the natural regeneration dynamics of native plant species, iv) increases the invasiveness of other non-native plants into the area, and v) native forests are able to recover after removal of *H. gardnerianum*. Study sites include i) Natural plots without impact of alien plants, ii) Ginger plots with a *Hedychium gardnerianum* dominated herb layer, and iii) Cleared plots that were treated with herbicide six years ago to remove alien plants, particularly *Hedychium gardnerianum*. Five permanent plots represent each of the three types mentioned above. Species composition, abundance of mature trees, saplings and seedlings were surveyed. Dissimilarities in species composition of adult tree species were assigned to differences in habitat conditions. Numbers of saplings and seedlings were lowest on Ginger area types, followed by Cleared and Natural area types. Development of seedlings into saplings strongly depends on light conditions, normally canopy openings. Dense Ginger stands act as a closed "canopy" and inhibit saplings growth. Results confirm the assumptions that *H. gardnerianum* has negative effects on forest processes. It suppresses germination and establishment of native tree seedlings (eg. endemic *Metrosideros polymorpha*), leading to a change in species composition. Furthermore, it was observed that *H. gardnerianum* does not show a negative impact on *Psidium cattleianum*, an invasive tree species. *P. cattleianum* is characterized by vigorous growth and could displace native tree species. Both species are probably capable of completely changing structure and species composition of Hawai'i's montane *Metrosideros* rainforest. On the cleared plots, native species successfully regenerate. Those sites should be able to regain their natural rain forest structure and native species combination.

T13.2

Phytodiversity and endemism in the Neotropics

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Based on critically selected monographic data concentrated in a database containing more than 4000 specific and subspecific taxa (approx. 5% of all Neotropical Angiosperms), a set of biodiversity and endemism maps is presented and analysed. The most prominent Angiosperm diversity centres occur along the Andes, in the Chocó Region, in Central America, the Guayanas and in the coastal Brazilian mountain ranges. The data suggest that the range sizes are small for most species. Approx. 84% of the species are covering less than 1 % of the Neotropical area. Defining narrow endemics as species occurring in 3 grid cells at most, we infer that plant cover in the Neotropics is mainly composed of an irregular mosaic of narrow endemics. We estimate that approx. 100 narrow endemics become extinct per year. Hence, adequate conservation strategies for Angiosperm diversity would require large protection areas in the Neotropics. Our data are in contrast to hypothesized Pleistocene refuge areas for the entire group of Angiosperms, but would support refuge areas of single taxa.

T8.2

Recent history and prediction of land use in Bolivia: Implications for biodiversity conservation.

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Land use change is the most important cause for recent loss of biodiversity in tropical ecosystems. Understanding its dynamics is crucial for developing and improving conservation strategies. We perform a systematic evaluation of land use changes and its impacts on biodiversity using Bolivia as a model country. Bolivia combines very high diversity both in primary ecosystems and land use forms with a low complexity of its economy.

Land use types are classified into 23 categories, according to main products, production intensity and affected ecosystems (e.g. extensive cattle-ranching in natural savannas). An analysis of the recent history of land use leads to the identification of the most important factors determining specific land use types, such as soil quality, accessibility, world market prices of cash crops, land ownership or historical land use tradition, among others. A simple econometric model is calibrated to explain current land uses according to these factors.

Comparative analysis of remote sensing data (NOAA 1993 and MODIS 2001) is used to quantify the recent land use dynamics.

Based on the probable future development of the factors influencing land use and the tendencies observed in the comparative remote sensing data analysis, scenarios of future land use patterns are elaborated, including possible impacts on Bolivia's biodiversity.

The results allow the quantification of probable impacts of land use changes on biodiversity, setting a baseline for proactive conservation planning. In Bolivia, the greatest loss of primary ecosystem area, currently and in the future, is due to industrial agriculture for the production of annual cash crops (soy bean, sugarcane, among others) in dry forests with rich soils, followed by cattle ranching on poorer soils in humid and semi-humid rainforests. Small scale farming by immigrants from the highlands, in the humid forests, is probable to cause important but less severe impacts.

Some of the conclusions that can be drawn out of the analyzed land use scenarios:

Protected areas are mainly situated in inaccessible areas with low opportunity costs. Where soils are suitable for industrial agriculture, conservation efforts might hardly reach more than the conservation of small representative examples of original ecosystems. In contrast, e.g., impacts caused by cattle ranching in Amazonian forests in northern Bolivia can be mitigated by extractive use of forest products like timber and Brazil nut as a realistic and rentable alternative, allowing the conservation of great proportions of intact ecosystems.

T12.4

Insect herbivores and their antagonists on individually variable plants

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The distribution of insect herbivores on conspecific plants is often highly aggregated, with some plants hosting high and other plants very low herbivore densities. Herbivore density affects the impact of insect herbivores on host plants and on coexisting organisms. Understanding the factors leading to a marked variation in herbivore densities on conspecific plants is therefore of great relevance for scientific and practical purposes. Even conspecific, syntopically growing plants may vary in numerous traits that influence herbivore distribution. These traits, rendering individual plants different for herbivores, are determined by plant genotype and by environment, or by genotype-environment interactions. They may affect the herbivore directly, for example as feeding stimulants or deterrents, or indirectly by altering herbivore exposure to antagonists. This contribution aims at demonstrating the diversity of interactions of insect herbivores with individually variable host plants and at assessing the role of direct and indirect effects for herbivore distribution. It will compare different herbivore-plant systems in natural and managed environments in the tropics as well as in temperate regions and discuss the generality of specific plant trait – herbivore relationships.

T4.1

Elevation effects on key processes of carbon cycling in montane rainforest of South Ecuador

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Tropical montane rainforests show great changes of floristic composition, above-ground stand structure and productivity with increasing elevation. Forest height, aboveground biomass and production are documented to decrease with increasing elevation. In contrast knowledge about elevational effects on belowground biomass and production and their relation to aboveground changes is low yet.

In our study we investigated key processes of carbon sequestration, allocation and turnover along an elevation gradient in a tropical montane rainforest in South Ecuador. We determined the tree biomass and annual production of leaves and twigs, fruits and flowers, stems and branches, fine- and coarse roots in five different mature forest stands in an altitudinal range from 1000 to 3000 m a.s.l. Mean tree height, tree diameter, leaf area index LAI, aboveground biomass and aboveground production decreased along the elevation gradient, while stem density increased. Basal area, leaf biomass and coarse root biomass were not correlated with elevation. The biomass, production and mortality of fine roots increased tremendously from 1000 to 3000 m a.s.l. The root/shoot ratio of trees increased more than 10 fold along the slope. Litter decomposition rates were significantly reduced at high elevations.

Decreasing LAI (1.8 fold), approximately constant area-based N content of leaves and no significant altitudinal trend of global radiation seem to implicate a decline in carbon gain, which may explain only in parts the 2.7 fold decline in aboveground biomass and the 21 fold decline in aboveground wood production.

On the other hand, low temperature and high soil humidity in high elevation caused water logged soils where O₂ availability is limited and nutrient mineralization is delayed. Thus, higher costs for nutrient acquisition at high elevations may induce fine root growth and turnover, and lead to greater belowground allocation. We conclude that the increasing allocation to fine roots on the cost of aboveground biomass might indicate an enhanced relative importance of this tree component to ensure sufficient nutrient supply at high elevations.

T8.8

Legacies of past anthropogenic disturbance on soil and tree composition in Kakamega tropical rainforest, Kenya

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Kakamega forest, one of the last remaining indigenous forests in Kenya has faced severe reduction, degradation and fragmentation over years due to anthropogenic pressure from the adjacent communities. These changes can drastically change plant species composition, since species adapted to forest ecosystems may be unable to persist where human land-use results in reduction or severe modification of forest vegetation. Changes in species composition could induce significant changes on the physico-biogeochemical properties of soils since vegetation is one of the major determinants of soil formation. Little is known of the ecological consequences of the disturbance history in Kakamega forest. This study investigated the long-term effects of past human disturbance on soil and tree species composition within ten sites in Kakamega forest. Secondary data from GIS information, forest history assessment and a disturbance assessment was used to categorize the sites into different disturbance levels. Two-meter deep soil pits were dug at each site and described according to standard procedures. Soil samples were collected at three depths up to 30cm depth at one meter distance from the pit in each of the cardinal directions to statistically compare the soils. The soils were analyzed for physical (bulk density, penetration resistance and texture) and chemical (pH, water extractable and total K, Mg, Ca) properties. Triplicate plots of 20 by 20 m were established in each site and all tree species with more than 5cm dbh were identified and enumerated. The most disturbed sites had high bulk density, low pH and significantly low concentration of water extractable K, Ca and Mg but there were no significant changes in total stocks of K, Ca and Mg. An ordination analysis of the vegetation and soil parameters revealed two distinct gradients: North-South gradient and a disturbance gradient. The southern sites were characterized by *Celtis-Craibia* plant alliance and were explained by total amounts of K, Ca and Mg while the northern sites were characterized by *Deinbollia-Markhamia* plant alliance and there no distinct soil parameters explaining these sites. The most disturbed sites were characterized by *Harugana* plant alliance and were explained by high penetration resistance, bulk density and silt content. These results show that high human disturbance leads to increase in acidity; depletion in nutrients, increase in soil compaction and on tree compositional differences. The current differences among the sites suggest that past land- use is an important factor controlling the soil and tree composition patterns in Kakamega forest.

T1.6

The effects of herbivory on interactions between pollinators and flowers in *Acacia* spp. (Mimosaceae) in Northern Kenya

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Acacias are among the most dominant woody plants in many tropical and subtropical semi arid habitats across the world supporting an enormous number of herbivores. The trees are of great economic value to human societies as they are used as sources of timber, wood fuel, fruits and secondary plant compounds. Owing to their importance, a lot of studies have focused on their growth ecology. Herbivory and reproduction are among the most studied aspects of *Acacia*. However, the interactive link between these two aspects and their effect on the growth success of Acacias is poorly understood. A study was carried out in northern Kenya to examine how flower production and floral resources vary when trees are naturally browsed by livestock and wildlife herbivores to different extents, and also how artificial simulation of browsing affects this. Data were recorded on floral morphometric measurements and dehiscence in different browsing levels and simulated herbivory plots. The number and type of visitors to the flowers was also recorded besides determining the species diversity of wild flora within the study site. The results indicate that both wildlife and livestock have a great effect on *Acacia* pollinator diversity causing a significant reduction both under natural and simulated herbivory. Generally, unbrowsed trees produced significantly ($P < 0.05$) more flowers, florets, anthers and larger floral diameters than naturally and heavily browsed *Acacia* trees. Similarly, unbrowsed trees attracted more pollinators especially bees than naturally browsed trees. An earlier pollinator peak activity was recorded on unbrowsed trees than browsed trees. A significant shift of inflorescence dehiscence time occurred between unbrowsed and naturally browsed trees of *A. nilotica*, ($KS=0.34$, $P < 0.01$), *A. brevispica* ($KS=0.34$, $P < 0.01$) and *A. etbaica* ($KS=0.33$, $P < 0.01$) across the day. The unbrowsed trees attracted significantly more pollinators than naturally browsed trees probably because the unbrowsed trees had larger flowers thereby becoming more visible to pollinators from a distance than those of browsed trees. The delayed floral dehiscence of naturally browsed trees could have been caused by modification of the microclimate around the flowers making them open later in the day than unbrowsed trees. This study has shown that *A. nilotica* and *A. brevispica* vary their floral resources greatly when browsed, whereas *A. etbaica* tends to show compensatory floral growth.

T4.3

Studying the impact of termites on soil properties: first results from the central Namibian Savannah

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Wide parts of the central Namibian Savannah are influenced by the activity of the mound building termite *Macrotermes michaelensi* (Sjöstedt). Informations about the impact of soil turnover done by these termites on the diversity of soil and soil properties and the role of termites in nutrient cycling processes are limited. Within this study, a mapping approach on the size, status, properties and distribution of termite mounds is combined with a detailed soil survey. The results provide a database for the long term monitoring of the establishment, age and decay of these mounds and allow an identification of the source of the mound material. Moreover, the data will contribute to the assessment of the small scale pedodiversity and its importance for biodiversity

The study area is situated in the Namibian Thornbush Savannah north of Okavango on a BIOTA Southern Africa observatory (www.biota-africa.org). Mean annual rainfall is app. 350mm (summer rain), the soil moisture regime is aridic to ustic. The topography is flat with unconsolidated materials of different textures as soil parent material.

Soil profiles were sampled in the centre of 34 plots of 1 hectare size. In the same area, a mapping of all termite mounds and their geometry was combined with a sampling of the mound material. Additionally, topsoil samples were taken from transects leading from mounds to their vicinity. Geochemical composition, texture and colour of all samples were determined in the laboratory.

First results show a mean density of 5 termite mounds or remnants of mounds per hectare with differences in the status of the mounds (active, inactive, size etc.). Texture and colour of the mound material indicate an origin of the deeper and loamier parts of the matrix soils. This material is permanently transported back to the surrounding of the mound by erosion and the decay of old mounds. In the presentation the importance of these processes for nutrient cycling and the soil diversity will be discussed.

T5.1

***Parkia pendula* and the mammals: herbivory, pollination and dispersal**

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Interactions of *Parkia pendula* (Willd.) Benth. ex Walp., a common canopy-building tree, with its mammal associates were studied in a 300 ha Atlantic rainforest fragment in Pernambuco, Brazil.

P. pendula was found to be pollinated by the bats *Phyllostomus discolor* and *Platyrrhinus lineatus*, whereas *Glossophaga soricina* as well as *Nasua nasua* and *Caluromys philander* only fed on nectar but did not cause pollination. The porcupine *Coendou prehensilis* was a very common herbivore on inflorescence-buds. The sticky seedpod-exudate was a popular source of nourishment for the gummivore *Callithrix jacchus*, the only primate in this forest fragment. These marmosets seemingly swallowed the seeds while feeding on the gum and therefore function as primary dispersers.

The animals associated with *P. pendula* represent ca. 20% of the known mammal fauna of the forest fragments north of Recife. Additional feeding experiments were done with several primate species and confirmed the appreciation for the pod-gum of species co-occurring with the plant. Therefore, *P. pendula* is as an important species for mammal conservation in the study region as well as in large parts of the Neotropics, because both, the tree and these mammals are widespread throughout lowland rainforests in Latin America.

In the presentation details of quality and quantity of the relationships of *P. pendula* and its mammals are shown.

Research was carried out within the project 'Disturbance, fragmentation, and regeneration of the Atlantic rainforest in the northeastern Brazilian state of Pernambuco' financed by BMBF (Project No.01 LB 0203) as part of the Mata Atlântica program.

T2.3

Are frogs suitable bio-indicators? Amphibian responses to altered African ecosystems

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The current worldwide decline of amphibians, about one third of the species are threatened, dramatically illustrates that amphibians are a group of organisms that reacts very sensitive to environmental changes. However, it is still debated in how far this sensitivity qualifies amphibians as suitable bio-indicators. We addressed this question in our investigations on the effects of human habitat alteration on West African amphibian communities. We studied amphibians in pristine forests and savannahs, selectively logged and fragmented forests and in heavily altered savannahs in Ivory Coast and Benin. In all cases amphibians responded to human activities in regard to system descriptors (e.g. species richness, α -diversity). However, usual diversity measures failed to detect the real amount of diversity loss, i.e. the loss of whole functional groups in altered systems. Moreover we detected that the amphibian communities system's dynamics, such as predictability, were altered. In summary our results confirmed amphibians sensitivity to habitat alteration, and provided broad evidence for the suitability of amphibians in general and special anuran groups in particular as bio-indicators for human impact on various tropical ecosystems. This study is part of the BIOLOG-program of the German Ministry of Education and Science (BMB+F; Project W08 BIOTA-West, FZ 01 LC 00410).

T10.7

Bracken (*Pteridium* div. spec.), a disastrous pest in tropical land management

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In many tropical areas the primary forest is cleared for agricultural purposes by slash and burn which triggers the invasion of bracken (*Pteridium aquilinum* s.l.). Vast areas of pastures and crop fields have been abandoned because of irrecoverable colonization by that fern. Up to now, no sustainable control treatment has been described to inhibit spreading of bracken in the tropics. The ecophysiological mechanisms on which the extraordinary competitive strength of this aggressive weed is premised were investigated in a perhumid mountainous area of South Ecuador. The rhizomes of bracken are heat-tolerant and sprouting of new fronds after a fire or heat shock is fast, being favoured under conditions which allow the persistence of its VA-mycorrhiza. Several methods of chemical weed killing are being examined in addition to mechanical weeding and the success will be reported in the presentation. Hitherto, there is also no method of biological control. Damage of the leaves by insects and other herbivores is little, but once a damage has been set, infection by pathogenic fungi (*Ascochyte pteridis?* and others) has a good chance. However, patchiness of infected bracken suggests the coexistence of various populations of bracken which exhibit different susceptibility for fungal pathogens. Indeed, in the area sympatric occurrence of several populations of the local *Pteridium arachnoideum* (Kaulf.) Maxon, could be demonstrated by genetic and isozyme analysis.

T13.7

Euglossine bees (Apidae, Euglossini) in the Northern Atlantic Rainforest of Brazil: Diversity, habitat requirements and importance as specialized pollinators

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The Euglossini are Neotropical bees with a key role as pollinators in tropical rainforests. They display specialized relationships with numerous associated plant species, including buzz-pollination flowers, resin flowers, long-tubed nectar flowers and perfume flowers. Due to their extraordinary high flight capacity they were repeatedly cited as long-distance pollinators in tropical rainforests. Because of the advanced cut down of the Atlantic Rainforest of Pernambuco, euglossine bees suffer from habitat loss. We asked: Which species of Euglossini occur in the Atlantic Rainforest of Pernambuco? Which species are most affected by habitat loss? Do euglossine bees leave forest fragments and which plant species depend on euglossine pollinators? At 11 points in 4 municipalities in the Atlantic Rainforest of Pernambuco, males of Euglossini were attracted to scent baits (benzylacetate, benzyl-benzoate, cineole, eugenol, β -ionone, methyl-salicylate, skatol, vanillin) at peak bee activity. At one location we simultaneously monitored the scent baits at seven sampling points along a straight-line transect leading from native rainforest up to 500m into the surrounding sugarcane monocultures to determine which species might link isolated forest fragments. To know if these long-tongued bees are effective pollinators of nectar flowers with long flower tubes, the body surfaces of 540 bees of 4 species of *Euglossa* were screened to map the localization and identify the adhering pollen. A total of 27 species of Euglossini were recorded (18 *Euglossa*, 4 *Eulaema*, 3 *Eufriesea*, 2 *Exaerete*). We found no clear relationships between fragment size and species richness, but the species displayed different relations to the closed forest. Number of rare species and diversity of euglossine bees were higher in well preserved areas. Bees of only 5 species were found on the scent baits in the sugarcane fields. The 10m sampling point outside the forest showed already a drastic reduction in species richness and abundance, indicating that the forest edge functions as a barrier for most Euglossini. Besides being specific pollinators of perfume-orchid flowers, our study shows that euglossine bees are also highly specialized pollinators of plant species with long flower tubes like those of Marantaceae. The bees frequently carried pollen of these flowers at hidden body parts like on the ventro-basal part of the proboscide where it can not be removed by the bee. Considering the dependency of many plant species on euglossine pollinators, the current devastation of the northern Atlantic Rainforest threatens their maintenance by reduced pollen flow and fruit set.

T2.1

Neotropical Ericaceae and their mycorrhizal fungi

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Ericaceae have a broad amplitude of distribution with centers of biodiversity in the northern hemisphere, Asia and the neotropics. Within the Ericaceae, the monophyletic Andean clade occurs exclusively in the Andes and in some parts of Central America. A hotspot of biodiversity of Ericaceae is located in the montane regions in Ecuador between an elevation of 1800 and 3300m a.s.l. Ericaceae have developed different life forms and occur in various habitats. The species of the Andean clade live in the primary and secondary forest mainly as epiphytes or hemiepiphytes, whereas many other ericaceous species in this region have a terrestrial life form and grow on areas exposed to direct sunlight.

Ericaceae are obligatorily associated with fungi and form mycorrhizal types that are not known from other plant groups. Hitherto, three mycorrhizal types for Ericaceae have been described, the ericoid, arbutoid and monotropoid mycorrhiza. However, the ericads of the Andean clade have not yet been intensively investigated with respect to their mycorrhizas. Our investigations in the mountain rain forest in Ecuador revealed that ericads of the Andine clade form ectendomycorrhizas. The dominating mycorrhizal fungi are species of the Sebaciniales (Hymenomycetes, Basidiomycota), which show a high biodiversity. Ascomycetes of the Leotiales are also involved in the ectendomycorrhizas with ericads of the Andine clade. Other investigated Ericaceae of Ecuador, which do not belong to the Andine clade, form ericoid mycorrhizas.

T3.3

Experimental management of nesting fields of the Melanesian Megapode (*Megapodius eremita*) in the Solomon Islands

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I report preliminary results from a study into sustainable harvests of megapode (Aves; Megapodiidae) eggs from colonial nesting fields. On Simbo Island, Solomon Islands, people harvest about 190,000 eggs of the Melanesian Megapode (*Megapodius eremita*) per year. Despite a 2 month closed season when eggs are not harvested, local people report declines in the number of birds and eggs, suggesting the harvest is unsustainable. I collected data on the size of the harvest, the efficiency of egg collectors, the incubation period of eggs, and used 780 eggs in an experimental study of the efficacy of hatcheries as a management tool. I built a mathematical model to investigate the number of chicks produced by closed season of varying lengths. Harvesters were highly efficient ($83.1 \pm 10.2\%$), meaning an egg had a 1:1000 chance of escaping the harvest. Eggs took 65 ± 12.0 days (SD, $n=70$) to incubate, which is longer than the closed season designed to allow eggs to hatch safely. Moving late-stage eggs from the fields to hatcheries did not result in higher mortality than eggs left in situ, and is therefore a viable management option. I estimate a closed season of 2 months produces 1,204-1,965 (95% CI) chicks, whereas one of 3 months produces 10,053-16,406 chicks. To generate a similar number of hatchlings, 60 hatcheries would need to be built and maintained. I recommend Simbo Islanders increase their closed season to 3 months to protect the megapode population from over harvesting.

T6.4

The role of immune gene variability (MHC) in parasite resistance in fragmented animal populations in the Tropics

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Habitat fragmentation generates barriers to gene flow by isolating subpopulations often resulting in a loss of genetic diversity due to genetic drift and inbreeding with possible negative effects on fitness parameters. In vertebrates growing evidence suggests that such genetic diversity is particularly important at the level of the major histocompatibility complex (MHC) because its gene products play an important role in immune functions. Diversity in the MHC is assumed to improve parasite resistance and therefore population viability. MHC variability is believed to be maintained by pathogen-driven selection, mediated either through heterozygous advantage or frequency dependent selection. However, empirical support for these hypotheses under natural conditions is rare.

We investigated the importance of the major histocompatibility complex (MHC)-constitution on the parasite burden of free ranging mouse lemurs (*Microcebus murinus*) in four littoral forest fragments in southeastern Madagascar. Fourteen different MHC class II DRB-exon 2 alleles were found in 228 individuals with high levels of sequence divergence between alleles. More non-synonymous than synonymous substitutions in the functional important antigen recognition and binding sites indicated selection processes maintaining MHC polymorphism. Animals from the four forest fragments differed in their infection status (being infected or not), in the number of different nematode infections per individual (NNI) as well as in the fecal egg counts (FEC). Heterozygosity in general was uncorrelated with any of these measures of infection. However, specific MHC DRB alleles were associated with parasite resistance or susceptibility. Whereas the allele Mimu-DRB*1 was more frequently found in infected individuals and in individuals with high NNI and FEC values (high parasite load), the alleles Mimu-DRB*6 and 10 were more prevalent in not infected individuals and in individuals with low NNI and FEC values (low parasite load). These three alleles associated with parasite load had unique amino acid motifs in the antigen binding sites. This distinguished them from the remaining 11 Mimu-DRB alleles. Variation in MHC allele frequencies in the fragments influenced the long-term survival of lemurs in the littoral forest fragments.

Our results support the hypotheses that MHC polymorphism in *M. murinus* is maintained through pathogen-driven selection acting by frequency-dependent selection. For the first time, this study provides evidence for the association of MHC variation and parasite burden in a free-ranging primate under natural selection conditions thus indicating the functional importance of the MHC in evolutionary ecology and conservation (*Cons Genetics* (2004), 5(3), 299-309; *Evolution* (2005), 59(2), 439-450).

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T6.8

Do epiphytic layers have a negative impact on cacao production?

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In cacao plantations with abundant growth of epiphytic bryophytes and lichens, epiphytes are frequently removed from trunks and branches of the cacao trees. This measure is taken based on the assumption that the epiphyte layer may negatively affect the development of the flowers and thus subsequently reduces cocoa yield (Pócs 1982). While epiphyte removal causes a significant reduction in species diversity (Andersson & Gradstein 2005), the impact of non-vascular epiphytes has never been investigated. We carried out a field experiment in Central Sulawesi, to determine the possible impact of epiphytic layers on cocoa yield. We selected 80 trees at four cacao-dominated agroecosystems (20 per site) with a comparable composition of diverse planted shade trees. Epiphytes were manually removed at each site from half of the trees. In addition, flowers of 10 trees per site (5 with and 5 without removal) flowers were hand-pollinated until at least 16 flowers successfully set fruit. The remaining 10 trees per site were subjected to natural pollination. All flowers and fruits were monitored and measured until fruits were harvested or died, for example by abortion.

The results did not reveal a negative impact of epiphytic layers on cacao productivity. Dry-weights of seeds, number of insect attacks and infections of black pod disease did not differ between trees with and without epiphyte removal. .

The experiment leads to the conclusion that removal of epiphytic layers from cacao trunks to enhance the cacao production is not necessary. By forbear from epiphyte removal, a more profitable plantation management in terms of man-hours and a more sustainable land use in terms of species richness are achieved.

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T13.6

Patterns of endemism of five plant and three animal groups in the Bolivian Andes

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Whereas regional patterns of species richness are usually readily interpretable in light of favourable climatic conditions and habitat heterogeneity, patterns of endemism, i.e., accumulations of species with restricted ranges, are not well understood. We mapped the distribution of all species of non-volant mammals, birds, reptiles, Acanthaceae, Baccharis (Compositae), Bromeliaceae, Pteridophyta, and Solanaceae (>3000 species in total) in a 0.25 x 0.25-degree grid on the eastern Andean versant of Bolivia based on over 100.000 individual species records, and compared the resulting patterns to GIS- and station-generated climatic and topographic variables. Species richness patterns of the eight study groups were more similar to each other than they were to the respective patterns of endemism, and vice versa, indicating that across all taxa richness and endemism are determined by different combinations of environmental factors. As expected, species richness was highest in regions with high temperatures, high precipitation, and high topographical variability. Endemism, in contrast, tended to be highest in areas with high relative interannual temperature and precipitation stability, suggesting that endemic species originate and survive best in ecoclimatically stable areas. Such areas are determined by special topographic situations that ameliorate the effect of ENSO events and subpolar cold air influxes. Human rural population density also peaked in areas with high ecoclimatic stability, but usually spatially slightly removed by about 25 km from the peaks of endemism. Our study has important implications for understanding the evolution of the extraordinary diversity of the Andean biota, and for conservation, watershed management, and land-use planning.

T7.2

Lessons from fragmentation research: improving management and policy guidelines for biodiversity conservation

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In an ideal world, science should inform policy development in all areas of human endeavor. Nowhere is this truer as in the case of human land-use and our impact on the natural environment. Unfortunately, real-life does not always conform to idealized situations, and in tropical forested areas facing serious threats, very little recent science has percolated into policy guidelines. Here, we present six areas of policy relating to land use practices in the tropics that should incorporate the most recent scientific information. In each case, we present the most recent science and what that information tells us in terms of formulating clear and applicable policy guidelines. It is our hope that this type of straightforward linkage between science and policy formulation will result in simple, yet powerful changes in human land use patterns and a concurrent positive effect on biodiversity and natural resources.

T12.3

Climate and Human Drivers of Fire Activity and Emissions from Peat and Vegetation Burning in Borneo, 1997 to 2003

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Fire is a significant determinant of vegetation dynamics, biogeochemical cycling and atmospheric chemistry at global, regional and landscape scales; and it is evidently increasing in size and frequency across the Tropics with often negative impacts on biodiversity conservation and emissions to the atmosphere. Previous studies estimate that the widespread fires associated with the exceptionally strong drought during the 1997 El Niño Southern Oscillation (ENSO) event in Indonesian forests and peat swamps released the equivalent of around 40% of global fossil fuel emissions released that year. This particular fire problem was exacerbated by large-scale land clearing and peat drainage in areas being cultivated as part of the Mega Rice project in southern Kalimantan. Somewhat surprisingly, even though the 1997 ENSO event extended well into 1998 (creating the so-called 'drought of the century' across SE Asia), and although 2002 was also an El Niño year, albeit slightly weaker in magnitude than 1997-98, there has been no long-term assessments of fire activity and emissions in relation to ENSO and land cover change in SE Asia.

Focusing on the island Borneo (comprising Kalimantan (Indonesia), Sarawak and Sabah (Malaysia), and Brunei), and using rainfall, population and soil data in combination with state-of-the-art satellite sensor data (LANDSAT ETM, MODIS, ATSR and AVHRR) to determine burnt area and deforestation patterns, we asked: How does ENSO affect precipitation and fire frequency (1997 to 2003)? What are the relative effects of ENSO and deforestation on spatio-temporal patterns in fire activity? What are the emissions from fires in peat, forests and in non-forested areas?

Here we present conclusive evidence that while the ENSO cycle sets the boundary conditions for fires to potentially occur, their actual occurrence is principally determined by deforestation and land conversion activities, which are more intensive in Indonesia than in Malaysia. Furthermore, emissions from biomass burning reflect fire patterns; specifically emissions of trace greenhouse gases from peat and vegetation fires are 3 - 4 times greater in El Niño years compared with non-El Niño years. Given that an ENSO event will likely return to Borneo in the near future, we highlight the need for urgent policy attention to address the demonstrable problems of widespread deforestation, high fire frequency and large-scale emissions from biomass burning there.

Spessa A, Weber U, Heil A, Siegart F (*In Prep.*) Impact of ENSO and deforestation on fire activity and emissions from biomass burning in peat, forests and non-forested areas of Borneo, 1997-2003.

T1.2

Each to their own: inconsistent responses of small mammals to rainforest logging in their movement trajectories and gastrointestinal parasites

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The impact of logging and other types of rainforest disturbances on animal populations is little understood. Such impacts result in a suite of environmental differences that may affect habitat conditions and population performances of wildlife and consequently the infestation patterns of local populations.

Small mammals in tropical rainforests are distinguished in their ability to exploit the habitat above the forest floor. Specific movement trajectories are determined both by intrinsic factors such as ecological specialization, morphology and body size as well as by structural features of the surrounding habitat. In turn, it is predicted that such distinctive features alter the interactions with other ecosystem components such as associated parasitic helminth faunas (Nemathelminthes, Plathelminthes), which are largely influenced by host characters.

We applied spool-and-line tracking in order to describe movement trajectories and habitat segregation of eight palaeotropical species from an assemblage of Muridae, Tupaiidae and Sciuridae in the three primary and three secondary rainforests of Borneo with a total of 13,525 m path being followed. Additionally, we investigated patterns of helminth species diversity in two rat species (Muridae) and two tree shrews (Tupaiidae) from the same assemblage by examining 337 faecal samples with faecal egg count (FEC).

Movement patterns were significantly distinct between all species with most similarities being found for congeneric species having a strong convergence in body size and morphology. All species were affected by the altered forest structure in the secondary forests. Overall shifts in microhabitat use showed no common tendency among species and were rather of contrasting trends for the convergent species *Maxomys rajah* and *M. surifer* and for *Tupaia longipes* and *T. tana* in multivariate analysis, suggesting that each species was uniquely affected in its movement trajectories by a multiple set of environmental and intrinsic features.

Following our expectation, such inconsistent differences among species in logged forests were also found in parasite assemblages, which were evidently influenced by rainforest logging. Species richness of nematode morphotypes and mean number of infections per host of *Tupaia longipes* were significantly larger in secondary forest than in primary forest. In contrast, *L. sabanus* was more heavily infected with cestodes in primary than in secondary forest and also revealed larger egg counts for Strongylida and Spirurida in primary forest.

Our results suggest that forest degradation and altered environmental conditions influence helminth diversity and infestation patterns of small mammals with inconsistent pattern among host species.

T12.6

Diversity of epiphytes across a gradient of human disturbance in an interandean dry forest, northern Ecuador

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Our understanding of epiphyte communities of tropical dry forests is fragmentary. The objective of this study was to analyse patterns of epiphyte species composition, abundance and richness across a gradient of human disturbance.

Field work was carried out at *Bosque Protector Jerusalén* in the dry interandean Guayllabamba drainage, Pichincha Prov., Ecuador (2300 m a.s.l., 530 mm prec./an.). Epiphytes on 115 trees of the monodominant *Acacia macracantha* were sampled in six different habitat types. These include mature mixed forest (20 trees), mature acacia forest (20), semi-closed secondary acacia woodland (15), mature forest edge (15), and isolated trees in pasture with high (15) and low (30) exposure to dust respectively.

In total 8 species of vascular epiphytes (5 Bromeliaceae, 3 Polypodiaceae) and 14 species of epiphytic bryophytes were recorded (10 mosses, 4 liverworts). Mature mixed forest and acacia forest did not differ significantly from each other in terms of surface covers and species richness, nor did isolated trees with high and low dust exposure respectively. The cover of vascular epiphytes was significantly higher on isolated trees compared to mature forest, whereas the cover of bryophytes was significantly lower. Species richness of vascular epiphytes was highest on mature forest trees and lowest on isolated trees, however, the differences were not significant. Epiphytic bryophytes, on the other hand, were significantly less speciose on isolated trees. Surprisingly, epiphyte assemblages along mature forest edges showed greater impoverishment than those in secondary woodland. We conclude that epiphytic cryptogams are excellent indicators of human disturbance in montane dry forests.

T6.5

Land use, land degradation and conservation issues in and around protected areas in eastern Cuba

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Land use, land degradation and resource conservation in two contrasting protected areas (humid Alexander von Humboldt National Park, semiarid Nature Reserve Baitiquirí) and adjacent land areas in eastern Cuba was investigated. Land use and land degradation was mapped in 2001. Further information about the study areas was collected by interviewing farmers and conducting rankings with key persons of the study villages.

Although most parts of the study area are influenced to various degrees by human impact, the different types of land use seem presently not to have a crucial or detrimental impact on the land resources of the Alexander von Humboldt National Park. However, exploitation of the natural resources in certain areas could be improved with different management options to reach sustainability as well as to meet the conservation objectives of the National Park. This includes reduced or abandoned agricultural use of steep slopes to reduce erosion risk as well as a facilitated regeneration of natural vegetation in many parts of the study area to be able to conserve the high valuable biodiversity of the Park. Environmental education seems to have played an important and successful role since the foundation of the Park in 1996. Since then, cropping on steep slopes as well as illegal logging and poaching could be reduced.

In the area of the Nature Reserve Baitiquirí grazing was found to be the main cause of degradation, followed by woodcutting and forest fires. Impact of grazing was found highest near the villages, decreasing with greater distance towards the mountains. Intensively grazed hillside areas showed higher degradation than extensively grazed areas. The vegetation of the Nature Reserve is only affected to smaller degrees by grazing and woodcutting due to geographical factors limiting access. The most crucial factor for land management in the study region appears to be the very shallow soils because they are highly susceptible to erosion. Some management options to combat land degradation seem to be feasible, but most options are limited by lack of finance, responsibilities or short-term effects. Although villagers' perception of degradation factors such as over-grazing is low, local initiatives to conserve their natural environment exist.

The two protected areas showed to be very contrasting in respect to conservation objectives, management of the protected area and conservation goals achieved so far. The Alexander von Humboldt National Park can be seen as positive example, whereas in the area of the Nature Reserve Baitiquirí many problems are yet not solved.

T12.5

Mountain refugia explain centers of endemism of vertebrates in Madagascar

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Madagascar is known for its high degree of endemism, its extraordinary biodiversity, and a very high degree of "micro-endemisms" with high species turnover on small spatial scales (very high beta diversity). Previous explanations which linked the occurrence of biota and speciation to vegetation formations or rivers as barriers were not satisfying. They could not explain the distributional limits of species and did not provide an explanation why specific areas have many regional endemics while others do not. On the basis of the analysis of 35,000 georeferenced land vertebrate species occurrences (data from field surveys, published literature, reports and museum specimens) and the creation of a detailed database of the island's rivers and associated watershed divides, we propose a new hypothesis to explain the evolutionary history of regional speciation in Madagascar's forest dependent biota. According to this hypothesis high mountains would have served as refugia during periods of drought. Rivers originating in these refugia would have served as retreat-dispersion route. Regions between these retreat-dispersion routes would have been isolated. This could have led to independent speciation in these regions. Thus, species differentiation could have occurred in the mountain refugia with subsequent dispersion during more mesic time periods and in the isolated regions between the retreat-dispersion routes. This scenario predicts several centers of endemism in the more lowland and coastal portions of the island. First tests of this hypothesis with modern regional centers of endemism match the predictions. The results allow to formulate explicit hypotheses for phylogeographic studies, and the determination of regions of further biological exploration and conservation priorities.

T7.3

Increasing leaf-cutting ant density (*Atta* spp.) in fragmented Brazilian Atlantic forests: causes and consequences

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Leaf-cutting ant (LCA) colony density drastically increased at the forest edge and in small fragments of Atlantic rainforest in Serra Grande (NE-Brazil). We report several findings suggesting that fragmentation effects promote LCA via the relaxation of both bottom-up and top-down-forces. On the other hand, we present evidence that the increased number of nest constructions, along with increased LCA herbivory, may in turn amplify fragmentation effects on forest structure and regeneration.

T12.1

What controls CO₂ exchange between the atmosphere and biosphere in tropical grasslands in the Okavango Delta, Botswana?

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Tropical grasslands represent about 15% of the global land surface, with a yearly net primary production second only after tropical rainforests. It is also likely that tropical savannas constitute a significant component of the terrestrial carbon sink. However, there have been no previous long-term measurements and process-based analyses of the eco-physiology of these ecosystems. Therefore, this study focuses on carbon and water cycling in a suite of tropical grassland ecosystems representing a broad hydrological gradient (permanently flooded grassland (PFG), seasonally flooded grassland (SFG), and rain fed grassland (RFG)). The primary aim was to improve understanding of the mechanisms constraining CO₂ uptake and release in these ecosystems. The three tropical grasslands showed pronounced spatial and seasonal differences in net ecosystem exchange (NEE). Maximum uptake rates of CO₂ during summer were 24 μmol m⁻² s⁻¹ at the RFG and PFG and 18 μmol m⁻² s⁻¹ at the SFG. During winter maximum NEE was 12 μmol m⁻² s⁻¹ (PFG), 5 μmol m⁻² s⁻¹ (SFG) and 0 μmol m⁻² s⁻¹ (RFG). Seasonal differences at the seasonally flooded- and rain fed grassland sites could be mainly attributed to the respective water regimes and the resulting presence or absence of green vegetation. Seasonal differences at the permanently flooded grassland were controlled by seasonality of temperature and light. To explain spatial variation in NEE, a simple model was fitted using leaf nitrogen content and the fraction of photosynthetically active radiation (fPAR). This model showed good results and suggests that spatial variation during summer was due to differences in foliar nutrient supply and the amount of standing biomass.

T8.7

The effect of forest disturbance on soil microarthropods along a land use gradient in Central Sulawesi, Indonesia

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In order to assess the influence of forest disturbance on the soil fauna and decomposition processes a study was conducted at the rainforest margin zone of the Lore-Lindu National Park, Central Sulawesi. Along a land use gradient consistent of four levels of disturbance (natural forest to intensively managed plantations) soil core samples from different horizons (0-3 and 3-6 cm, respectively) were taken and extracted by heat. The extracted animals were sorted in taxonomic groups and oribatid mites and collembolans were further determined. Additionally, leaf litter was extracted to assess the abundances of soil macrofauna. Further, soil characteristics (Al, Ca, Fe, K, Mg, Mn, Na, CEC_{eff}, C/N, pH, soil water content), litter depth and temperature in 10cm height were measured. Preliminary results show that the composition of soil fauna changes along the land use gradient. Already low levels of disturbance in natural forests led to a strong decline in densities of oribatid mites and collembolans compared to agroforestry systems. Soil nutrient contents and pH were conditioned by the soil type. The soil water content and the litter depth significantly decreased with increasing land use intensity whereas the daily mean temperature increased.

T12.7

Poster – Abstracts

Sustainable use and practical approaches in the framework of BIOTA West Africa

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In the framework of BIOTA West routes to sustainable use of natural resources and measures of restoration of degraded areas are being explored. This applied aspect of our work is only possible due to basic research results which enable us to make scientifically well-founded suggestions and optimize suggestions and management plans.

Four case studies out of the BIOTA West project are being presented:

1. Restoration of degraded ecosystems

Soil degradation is a serious problem in the tropics. By using the method of deep ploughing to destroy the soil crust combined with planting of saplings of endemic pioneer tree species decisive steps towards the restoration of near natural ecosystems can be executed. Additional protection against pasture improves the regeneration considerably.

2. The Zaï system

The Zaï-system is a traditional agricultural system which uses termites to improve agricultural productivity by altering soil characteristics like water holding capacity, porosity and nutrient contents to improve harvests.

3. Botanical gardens and tree nurseries

Many multipurpose tree species (medicinal plants, fire and construction wood) are rapidly declining in abundances due to unsustainable overuse and logging. By creating protected plant gardens and cultivating special species in tree nurseries the long term supply with these species can be achieved.

4. Fisheries and Aquaculture

Fish is one of the main protein sources in large parts of Africa. Nevertheless, aquaculture plays only a very minor role. BIOTA West is trying to optimize the different local systems of aquaculture (from feeding fish in small ponds to complex cage farming), to adopt them to the different local conditions (especially to increase the acceptance in the local population) and to choose indigenous fish species appropriate for stocking on the basis of fundamental knowledge about their biology and their role in their ecosystems.

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P10.11

Differential mobility in two small phyllostomid bats, *Artibeus watsoni* and *Micronycteris microtis*, in a fragmented Neotropical landscape

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To assess the influence of habitat fragmentation and isolation on two small bats, the frugivorous *Artibeus (Dermanura) watsoni* and the insectivorous *Micronycteris microtis* (Phyllostomidae), we determined home range size and mobility of both species by radio-tracking on several different-sized islands (2.8 – 17 ha) in the Gatun Lake area in Panamá. Home range size was highly variable in the five tracked *A. watsoni*, ranging from 1.8 to 17.9 ha with a mean of 9.0 ± 6.0 (SD) ha. Three of the bats used more than one island for foraging. In this case, home ranges encompassed one or two islands and/or parts of nearby peninsulæ. Foraging areas were with 4.3 ± 1.9 ha about half as large, as most home ranges included rather large areas over water. *Artibeus watsoni* was more mobile than expected because of its small size, as some individuals flew regularly between island(s) and/or the mainland, sometimes several times per night. They traversed up to 180 m of open water. Our data suggest that food availability rather than island size primarily determined the number of islands visited by these bats. Scarcity of fruiting trees during the period of tracking might explain why the bats had to commute to other islands or the mainland for foraging. In comparison, home ranges of three *M. microtis* were with 3.8 ± 3.2 ha half as large as in *A. watsoni* and ranged from 1.6 to 7.5 ha. Foraging areas were with 2.5 ± 2.1 ha only slightly smaller. No individual of *M. microtis* was observed to fly over open water. This and their small home range size hint at this species likely occurring on at least some of the larger and more isolated islands as isolated, resident populations. There was no obvious difference in home range size and range use between individuals of both species living on the small islands and individuals living on the larger Barro Colorado Island (BCI), where another radio-tracking study had been conducted before. Only the number of core areas used by *A. watsoni* on BCI was significantly higher than on the smaller islands, which might be explained by a higher abundance of fruiting trees and night roosts. These results reveal different strategies that permit both species to survive in fragmented habitats. However, in this study distances between fragments usually encompassed less than a few hundred meters. Thus fragmentation effects might become stronger with increasing distance between fragments.

P12.4

Highly diverse symbiosis of glomeromycota and liverworts in southern Ecuador

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The project comprised systematically and ecologically research on the symbiosis of glomeromycota and liverworts. As first project we pursuit this fungi liverwort interaction against the background of a natural forest ecosystem: Our investigations took place in the tropical mountain rain forest of southern Ecuador and its surroundings and joined the multidiscipline German research unit there (DFG 402; www.bergregenwald.de). The reference area accounts for a high biodiversity and a model character of a pristine mountain rain forest. For our studies we chose the basal liverwort family of the Pallaviciniaceae with its seven local species in three genera. These most important terrestrial liverworts in the tropical Andeans are wide spread, ranging from an altitude of 1000 m at the lower borders of the study site to the timberline at 3000 m as well as growing in primary forests and as pioneer on secondary habitats, such as banks and slopes. The sampled Pallaviciniaceae were checked for mycorrhization; morphological observations and molecular analyses (18S rDNA similarity and phylogeny) identified the fungal partners.

Summarizing our investigations have shown (1) that all species within the Pallaviciniaceae were obligate mycorrhized with fungi of the glomeromycota. (2) The mycorrhization was found in all examined habitats, i.e. over the altitudinal and the disturbance gradient. (3) Basal liverworts in the tropical mountain rain forest of southern Ecuador have their own glomalean symbiosis: The glomeromycota are host specific to these liverworts and crucially differing from the fungal partners of arbuscular mycorrhiza within higher plants. (4) In contrast to previous assumptions emanating from only a few glomeromycota species in many liverworts the results indicate a highly diverse symbiosis. Various glomalean sequence types were found, none of them belonging to any so far known species. They form their own phylogenetic clades spread over the basal and derived glomeromycota taxa of Archaeosporaceae and Glomus group A (sensu Schüßler). (5) Moreover the symbiosis is highly complex: each liverwort species interacts with diverse symbiotic fungi and even a liverwort individual hosts several glomeromycota partners at the same time.

P3.3

Dynamic and pattern of water - and mass flows in disturbed and undisturbed soils in a tropical mountain rainforest in southern Ecuador

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In our ongoing investigation we will try to identify and parameterise vertical and especially lateral water- and mass flows in the unsaturated zone within different small catchments in a tropical mountain rainforest in southern Ecuador. The differences between these catchments are based on anthropogenic impacts and landslides. We want to know how water- and mass flows have changed outgoing from a primary forest small catchment. Earlier studies showed strong variability of hydrologic values in these catchments, whereas macropores, preferential flowpaths and their spatial distribution have not yet been investigated in detail. Therefore, the main focus of our investigation in southern Ecuador is to identify and examine macropores and preferential flowpaths using dye- and salt tracers. Field work recently concentrates on primary und secondary forest. Experiments will be conducted on micro-, meso- and macroscale. Within the microscale (range of several metres) passage of rainfall through the organic layer and migration of water on and in mineral soil can be observed by using Brilliant Blue as tracer. On mesoscale (range of 10m to 20m) we will use bromide, iodide and Na-fluorescein for evaluating recovery of tracer as well as parameters of mass transport. Within the macroscale (range of 20m to 50m) velocity of water flow (resp. tracertransport) and recovery of tracer in correlation with intensity of rainfall will be investigated. Key element of our presentation is a 2-dimensional conceptual hydrological model of a small catchment representing a primary forest. More detailed expositions demonstrate differences in soil types, soil texture, thickness of soil horizons, macropores and preferential flowpaths against position on the slope within the catchment. Possibilities for the application of these methods on different slope situations will be discussed. The description of each method contains, beside its experimental design and aim, software-based parameterisation of field data that optimises our conceptual model.

We would like to thank the German Research Foundation (DFG) for funding our project.

P6.6

Structural and molecular evidence for high diversity in arbuscular mycorrhizas of the andine cloud forest

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Arbuscular mycorrhizal fungi (AMF) are among the most important plant symbionts. They play a basic role in nutrition of plants, especially when phosphate is limited in soils. Molecular and morphological investigations of mycorrhizas of trees in a tropical mountain rain forest in the Podocarpus National park of southern Ecuador revealed an intensive colonisation with AMF which showed a high diversity. In phylogenetic analyses the obtained sequences (part of the nuclear 18S ribosomal RNA gene) clustered in the Glomeraceae, Diversisporaceae, Acaulosporaceae, Gigasporaceae and Archaeosporaceae. The highest diversity was found in Glomus Group A.

Light microscopy of fine roots of *Alzatea verticillata* showed a high colonization of intraradical mycelium, arbuscules and vesicles. Furthermore they produce a high amount of mycelium on the root surface with large appressoria with fine and big lobes. The characteristic branching modus of the mycelium turned out to be an important feature to define AMF morphotypes. The great amount of the supra-radical mycelium with its large appressoria is not described from AMF of herbaceous plants and it is presumably only formed in symbioses with trees.

P3.2

Capacity Building in the framework of BIOTA West Africa

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West Africa is the poorest region of the world. The UNDP Human Development Report of 2005 (<http://hdr.undp.org/reports/global/2005/>) is listing 177 countries. Burkina Faso is on position 175, Benin 162 and Côte d'Ivoire 163. The countries depend on cash crops for their national income (mainly cotton and cacao) and up to 50% of the population in these countries lives below the national poverty level. Due to this severe poverty problems education has no priority and these circumstances lead to an extreme underdevelopment and a severe situation of the universities. They lack almost everything: access to scientific literature, funds for excursions and practical work, scientific consumables and partly even labs or adequate lecture halls. There are often neither scientific collections and botanical gardens nor the funds for field trips. Temporarily even telephone and email do not work properly. The biggest problem, however, is the lack of scientific staff. The African scientists – many studied abroad - suffer from several aspects of this underdevelopment (lack of funds, of infrastructure and of scientific exchange with international colleagues) and often leave their countries as a consequence ("brain drain"). Pursuing scientific studies under these conditions is very difficult and more so as efforts in this respect are hardly appreciated. These big hurdles to an effective formation of young researchers can only be overcome by help from abroad. In the framework of BIOTA West 37 African students receive a profound scientific education. None of them had any other option for funding. By reinforcing the training facilities and infrastructure at the universities, BIOTA West managed to improve the general conditions for students and teachers at the universities and during field work. Capacity Building is not unidirectional and must not be mixed up with developmental aid. A scientific project like BIOTA West offers the chance to sustainably improve the situation at the universities. By building up the scientific capacities in these countries we can contribute to solve the urgent problems of biodiversity protection and develop methods for the sustainable use of natural resources applying locally adapted solutions.

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P10.4

BIOTA West Africa

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In the main phase, the goal of BIOTA-West is generating applicable knowledge for the maintenance and sustainable use of biodiversity in West Africa. To better succeed in this goal BIOTA-West has been restructured according to problem-oriented considerations, i.e. we bundled subprojects into a hierarchical and inter-linked structure consisting of three research units working on three levels.

Global and land cover changes on a regional and sub-continental level.

To understand the dimensions and causes of biodiversity changes, we employ on regional to continental scales remote sensing, climatology and different modelling techniques. On the local scale, we focus on groups of organisms selected on the basis of their functional importance in ecosystems. These key taxa are also used as suitable indicators for environmental states and suitable for monitoring their changes. In a comparative approach, we assess diversity patterns of these groups both under natural and anthropogenically influenced conditions. An important facet of this approach is the inclusion of socio-economic and socio-cultural drivers of human impact on landscapes. The integration of different spatial scales allows the upscaling of findings on the local scale and downscaling of patterns on regional to continental scales.

Effects and consequences of Global Change. This level assesses the consequences of biodiversity loss in the context of ecosystem functioning. How do changes in biodiversity influence ecosystem services? Here, we pay special attention to effects on ecological functions and economic values. Our studies comprise case studies focusing on human-induced biodiversity effects in plants, animals (ants & termites, fishes, amphibians, bats) and on plant-animal interactions as well as on animal-soil relationships within the framework of socio-economical and socio-cultural perceptions and demands. On the broad scale, we will detect which areas and taxa are most exposed to global change, in particular considering potential shifts of the geographic ranges of species.

Sustainability. Here we strive for 1) predicting and modelling future scenarios, 2) fulfilling demand-driven capacity building, and 3) accomplishing the design and implementation of concrete action plans, e.g. establishment of botanical gardens and herbaria, zoological reference collections, breeding of endangered or medicinal species, furthering locally adapted aquaculture and improving alternative agricultural practices such as the Zai system.

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P10.6

Multiproxy analysis of growth variations of *Prumnopitys montana* (Podocarpaceae) in a mountain rainforest in Southern Ecuador

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The analysis of growth changes of long-living trees can be used to reconstruct the long-term climatic variability and environmental changes of the tropics that are presently hardly understood. One methodological problem is the correct interpretation of wood-anatomical features to triggering climatic events since the seasonality of climate is generally weak in tropical mountain environments. We applied a multiproxy approach to study the relationship between stem diameter increment, the formation of new cells within the xylem body of the stem and seasonal climate variability in a tropical mountain rainforest in the Province of Loja, southern Ecuador. We combined high-resolution dendrometer measurements with the analysis of wood-anatomical thin-sections and densitometric analysis of wood microcores that had been collected in monthly intervals. It was possible to assign periods of cambial activity and cell formation to the onset of the rainy season in October/November. During the dry season from May to September, cell formation ceased and the stem diameter showed a decreasing trend caused by strong stem shrinkage during daytimes. The formation of wood density bands was confined to prolonged drought periods during the dry season as well as during the wet season. These investigations on the connection between short-term climate variability and wood formation are the basis to understand the pattern of wood density fluctuations found on long increment cores of *Prumnopitys* that will be utilised to analyse climate variability during the last centuries.

P11.2

Tolerance to drought stress of papaya seedlings inoculated with arbuscular mycorrhizal fungi (AMF) and fertilized with phosphorus

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An experiment under greenhouse conditions was conducted to evaluate if the alleviation effects to drought stress of papaya (*Carica papaya* L. var. Solo) seedlings is due to arbuscular mycorrhizal fungi (AMF) inoculation and/or phosphorus (P) fertilization. Seedlings of papaya were transplanted to pots inoculated or not with spores of *Gigaspora margarita* and *Glomus mosseae* at 4 levels of P (0, 50, 100 and 200 ppm). 4 months later the drought stress plants had the irrigation withdrew for 10 days. The leaf water potential (LWP), photosynthesis rate (PR), transpiration rate (TR), Biomass, P content were analyzed in the plants. The results indicated that the effect of drought stress was significant on some physiological parameters (PR and TR) except for the LWP; on the biomass and on plant mineral nutrition at 100 and 200 ppm of P fertilized. The positive effect of AMF inoculation was observed on the biomass at 0 ppm of P; on the P content at 0 ppm; and on the TR under drought stress at 100 ppm of P. The root colonization by AMF decreased with P levels increasing, but the impact of drought stress was not detected.

P3.4

Are Riodininae (Lepidoptera: Lycaenidae) really rare? A case-study of temporal variation in abundance

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Rarity is a central issue in Ecology and Conservation, though this term differs in definitions and assumptions, causing some confusion in its use. Butterflies of the subfamily Riodininae (Lepidoptera: Lycaenidae) are a good model to study this issue, because many species are considered rare or uncommon. In the present study, we aimed to investigate the temporal variation of this subfamily in a savanna remnant ("Pé-do-Gigante", Vassununga State Park) in southeastern Brazil. During one year, we conducted fortnightly visual censuses recording the number of individuals for each species observed in the area. Two species received the focus of our attention; one considered to be "rare" (*Theope nycteis*) and another considered to be "common" (*Phaenochitonina fuliginea*) among lepidopterologists. We observed 1,297 individuals of Riodininae; *T. nycteis* represented 16% and *P. fuliginea* 19% of all counts. Riodininae were more commonly observed during the post-rainy period, from March to May, when 53% of the observations were made. Within this period, we observed a single high peak of *T. nycteis* (97% of all records in 30 days). This species showed a high variation of abundance in time, being very common for a short period and scarce or absent for the rest of the year. In contrast, we observed a less concentrated pattern of distribution in time for *P. fuliginea* (44% in one season). This species could be found all year round, and in this way could be considered a "common" species, though not always in high abundance. Therefore, although belonging to the same "rare" subfamily, these two species seemed to have distinct abundance patterns. One species could be found all year round in low abundance and the other was very abundant but only during a short period. It would be interesting to study more fully the life cycle of these and other riodinines to understand ecophysiological mechanisms that determine variation of the abundance of adults. We also suggest that some butterfly species are misunderstood as rare, especially when they fly in a short period and could be overlooked or underestimated.

P7.5

The Hypolithon of the Knersvlakte - community and microclimate

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The Hypolithon, a community of photosynthetic and heterotrophic organisms (mainly cyanobacteria with co-occurrence of green algae, diatoms, fungi and bacteria), exists on the sides and underneath translucent stones (e.g. quartz) and appears as a 0.2-0.5 mm thick, blue-green film. Hypolithic communities occur widespread around the world in arid and semi-arid landscapes. We found a high abundance of hypolithic growth with 69% of the quartz stones colonised by hypoliths in the BIOTA observatory Flaminkvlakte on the Knersvlakte (Western Cape Province, South Africa), a semi-arid gravel plain with large tracts covered by a dense layer of quartz stones. Thicker and heavier stones appeared to be preferably colonised and photosynthetic biomass expressed as *chlorophyll a* reached mean values of 88.1 mg/m². The generally low nitrogen content of the soil was increased within the hypolithic crust and the delta 15 N isotope signature indicates a rapid turn-over of nitrogen, raising the question how the Hypolithon influences the diversity of higher plants (N-input). Regarding cyanobacterial species composition *Chroococcidiopsis* appeared to be the most abundant genus in the hypolithic community. Generally, species without UV- and light-protecting pigments favoured the habitat due to reduced light intensities under the stones. Microclimatic measurements revealed a moderating effect of quartz stones on extreme external temperatures. During the hottest month of the year (January 2005) the hypolithic habitat was consistently cooler (> 2 K) than at the quartz stone surface. This effect was reversed at night, when the temperature under the stones was higher than at the stone surface. Those temperature differences could have an effect on water condensation at the quartz stones and therefore water availability within the Hypolithon, which will be investigated in a next step.

P10.1

Rainfall partitioning in differently managed montane forest stands in Central Sulawesi, Indonesia

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Management activities alter the structure of many tropical forest stands which can be expected to influence the magnitude of canopy water fluxes. The objectives of this study were to determine throughfall, stem flow and rainfall interception in differently managed forest stands, and to relate the observed pattern of rainfall partitioning to stand structural characteristics. The study was conducted in a lower montane rainforest region (800 - 1140 m) in Central Sulawesi, Indonesia. Stands of four management types (natural forest, forest subject to small-diameter timber extraction, forest subject to selective logging of large-diameter timber, and cacao under trees remaining from the natural forest) were analyzed with three replicates per use type.

The mean tree height (trees ≥ 10 cm dbh) decreased from 21.3 in the natural forest to 17.5 m in the agroforest. The estimated leaf area index (LAI), as derived from hemispherical photos, averaged $6.2 \text{ m}^2 \text{ m}^{-2}$ in the natural forest, 5.3 in forests with small timber extraction, 5.0 in forests with large timber extraction and 5.3 in the agroforest. The annual gross precipitation close to our different study plots varied locally between 2633 mm and 3687 mm during the time of the study. The mean throughfall was 66 % of gross precipitation in the natural forest, 81 % in forest with small timber extraction, and 82 % in forest with large timber extraction and in the agroforest. Stemflow was approximately 1 % in all studied use types. Rainfall interception was highest in the natural forest where on average 33 % of the gross precipitation was re-evaporated back into the atmosphere, and much lower in the three other use types (17 % to 18 %). Leaf area index or canopy cover did not correlate significantly with rainfall partitioning. In contrast, a significant increase in throughfall percentage with decreasing mean tree height (≥ 10 cm dbh) was observed ($r^2 = 0.63$). A possible explanation for the tree height - throughfall relationship is that taller trees allow a more effective energy exchange, and hence lead to an increased re-evaporation of intercepted water and a reduced throughfall.

P8.2

The impact of land use on flying foxes, seed dispersal and vegetation dynamics in northern Benin

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In West Africa, rural populations still depend to a large extent on subsistence farming. Increasing human population and intensification of land-use is leading to overexploitation of natural resources, with woody plants being especially affected. This might result in a decline or breakdown of natural regeneration, potentially threatening the livelihood of humans who depend on these resources. For example, the shea butter tree (*Vitellaria paradoxa*; Sapotaceae) is the most important cash-generating indigenous species in northern Benin, but it is currently not cultivated and critically depends on pollinators as well as seed dispersers for its maintenance. To assess the impact of land-use on ecosystem services, in particular the functional role of fruit bats (Chiroptera: Pteropodidae) as seed dispersers, we

- i) inventoried woody plants on 14 permanent sample plots in the Pendjari region of northern Benin (7 in protected area, 7 in village area),
- ii) mapped the spatial distribution of 3 target species (GPS), including their population structure (dbh),
- iii) monitored the phenology of food plants (flowering & fruiting),
- iv) sampled relative abundance of fruit bats on the permanent sample plots, including their temporal use of food resources, and
- v) conducted germination tests of selected, bat dispersed trees.

According to our preliminary data, current agroforestry systems in the Pendjari region reduce species richness and alter community composition of woody plants. Changes in density and population structure of plants, which reflect their socio-economic value, potentially lead to decreasing resource availability for fruit bats. In turn, abundance and species composition of fruit bats is altered, which might impact natural regeneration of plants that depend on them for seed dispersal. Our study focuses on this crucial ecosystem service for the long-term maintenance of natural resources. Current and future results will help to establish management strategies for sustainable use incorporating these critical links for ecosystem functioning.

P2.7

Living outside but cutting within: high colony densities of leaf-cutting ants in front of the forest edgeDohm, C.¹, Meyer, S.T.^{1,2}, Leal, I.R.² & Wirth, R.¹¹Department of Plant Ecology and Systematics, University of Kaiserslautern, Germany²Department of Botany, Universidade Federal de Pernambuco, Recife, Brazil

Leaf-cutting ants (LCA) are dominant herbivores in neotropical rain forests. Since herbivory pressure increases with the abundance of nests, estimates of the colony density are needed to assess the impact of LCA on the forest. Until now colonies outside the forest have been largely ignored when calculating colony densities. We counted colonies of *Atta cephalotes* and *Atta sexdens* along 20-m wide transects parallel to the forest edge (15m outside and 5m within the forest) of a 3500-ha forest remnant of the Atlantic Rainforest in NE Brazil. Colony density peaked at 2m from the forest edge, with more than 95% of all colonies located within a 13-m zone spanning the forest edge. The density within this zone was 10.6 colonies/ha - much higher than that previously found in the interior and a 50m border zone of the forest (1.1 and 6.1 colonies/ha, respectively). Outside the forest we found foraging signs of LCA in only 3% of all colonies independent of matrix type (85% young sugar cane, 7.6% pasture, 7.4% shrub land). On the other hand foraging activity of 94% of the colonies was restricted to the forest vegetation. We conclude that the matrix vegetation, especially sugar cane, is less suitable as a food source for LCA than the forest edge vegetation. Consequently, the optimal nest location of a colony should be within rather than outside the forest, where it misses half of its main food source in its direct vicinity. The fact that colony densities were found to be higher outside the forest might be due to the attractiveness of bare soil to founding queens or to other advantages related to the maintenance of nest constructions.

As a consequence of this colony survey we suggest that, within the first 50m of the forest, the herbivory pressure by LCA is about 40% higher than previously estimated.

P12.19

Biological soil crusts: biodiversity, functional diversity and their environmental determinants

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Consisting of cyanobacteria, algae, lichens, microfungi, other bacteria and mosses in various proportions, Biological Soil Crusts (BSCs) colonize open spaces between higher plants. They are found worldwide in arid and semi arid habitats and can impact germination, growth, development and diversity of higher plants. They might change course and velocity of recovery and succession processes in their surrounding. The ecological relevance of BSCs influenced by their organismic composition and biomass. In the framework of the BIOLOG-project BIOTA we investigate the role and composition of cyanobacteria in BSCs along a transect from northern Namibia to the Cape region in South Africa covering various habitats in winter and summer rain climate. Up to now, 91 taxa of cyanobacteria and 37 green algal taxa were identified. BSCs were found in the observatories of all biomes along the transect except the Fynbos. Species diversity of cyanobacteria and green algae seems to be independent of the precipitation amount whereas chlorophyll values of the winter rainfall area exceed the values of the summer rainfall area. Photosynthetic soil biomass expressed as chlorophyll content refers to chlorophyll values of phytoplankton density detected in the adjacent Atlantic Ocean. As the nitrogen content of soils in summer and in winter rainfall area was comparably low, we expect a high influence of BSC on the nitrogen pool of the soil. The distribution patterns of different lichen growth forms within the lichen fields of the Namib Desert were analysed according to different strategies in the use of water resources. The measurements revealed that at high air humidity, crustose lichens showed the most negative osmotic potential, whereas during fog, fruticose lichens combed water out of the air. The utilization of dewfall showed no characteristic pattern with respect to the growth form. In a polyphasic approach morphology and sequence data (16S rDNA, intertranscribed spacer (ITS)) of cyanobacteria and green algae are combined to give reliable results on species diversity.

P10.15

Introduction in camera trapping - basic methods and equipment

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Camera trapping is an effective way to record information about animals or interactions which are usually difficult to be monitored in the presence of human disturbance. Basic methods and equipment as well as advantages and disadvantages of different setups will be presented.

P6.1

The function of canopy structure for patterns of soilmoisture and water availability for plants in a tropical mountain rainforest of Southecuador

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The availability of water and nutrients is a key factor for plant growth and regeneration. There is a close relation between the canopy structure and the soil moisture distribution in tropical mountain rainforests, which is important for the environmental conditions for plants and the potential of regeneration in closed forest. The canopy of tropical rainforests produces spatial patterns of throughfall which are very different on a small scale of some meters than the quite homogenous rainfall above the vegetation. In our study we compared rainfall and the distribution of throughfall and soil moisture in a tropical mountain rainforest of south Ecuador with daily measures over eight month.

In our study areas of 20m x 20m we found differences in throughfall intensity from 5% up to 500% of rainfall intensity. The patterns of throughfall distribution continue in patterns of soil moisture distribution. Especially in the dry season these pattern provide very different abiotic conditions for plant growth and more important for regeneration.

P8.3

Floristic differentiation of the Pteridophyta along abiotic gradients in a montane rain forest of the Mata Atlântica in the Parque Nacional da Serra dos Órgãos, RJ, Brazil.

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Within the BMBF funded project BLUMEN (Biodiversity and integrated land use management for economic and natural system stability in the Mata Atlântica of Rio de Janeiro) we studied the floristic differentiation of Pteridophyta along abiotic gradients in a montane rain forest of the Mata Atlântica in the National Park Serra dos Órgãos, RJ, Brazil.

In this study area the flora of the Pteridophyta was characterized along an altitudinal gradient (1130 to 1620 m a.s.l.) within 21 sample sites (each 400 m²). In these sample sites all terrestrial individuals as well as trunk epiphytes (growing up to two meters high) were registered. From each sample site topographic (e.g. altitude, inclination, slope aspect) and abiotic variables (light conditions, soil characteristics) were documented.

The aims of this investigation were the analysis of the abundance structure of all occurring species of Pteridophyta, their classification based on floristic similarity and the analysis of the dependence of the floristic variability on topographic and abiotic factors.

Within the scope of this work the Pteridophyta show a high species diversity in the understorey of the study area with a total of 115 species. The fern species pertain to 43 genera and 19 families. The most diverse fern families are the Polypodiaceae (18 species), Dryopteridaceae (14 species), Hymenophyllaceae (13 species), Aspleniaceae (11 species) and Grammitidaceae (10 species).

In the 21 sample sites a total of 17.041 fern individuals were recorded. The most abundant ferns were *Elaphoglossum vagans* (Lomariopsidaceae), *Polybotrya rosenstockiana* (Dryopteridaceae), *Polypodium pleopeltidis* (Polypodiaceae) and *Asplenium radicans* var. *uniseriale* (Aspleniaceae).

The fern flora of 19 sample sites could be classified in three different floristic groups corresponding to their floristic similarity using Cluster analysis, Two Way Indicator Species Analysis and Correspondence Analysis. Each group is characterized by and can be named after one dominating fern species (*Elaphoglossum vagans*, *Asplenium radicans* var. *uniseriale*, *Polybotrya rosenstockiana*). In addition we were able to identify typical species for each group using the Indicator Species Analysis.

For the three floristic groups we distinguished three different fern habitats in the study area, which can be differentiated by the environmental parameters altitude, slope aspect, slope curvature and the proportion of rocks in the sample sites using the Canonical Correspondence Analysis. These four parameters explain 41 % of the floristic variation between the sample sites and in conclusion the Pteridophyta is a good indicator group for these parameters in this study.

P7.4

Broad-scale diversity patterns of bats and their conservation priorities across West Africa

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Large-scale patterns of species richness and endemism constitute the necessary basis 1) to disentangle the factors which generate and maintain biodiversity, 2) to test the assumption of surrogacy, i.e. if different taxa show similar patterns, and 3) to analyse these patterns with respect to the existing network of protected areas. However, the distribution of most organisms on earth is insufficiently known and current knowledge heavily biased by unequal sampling effort. Modelling of potential distribution ranges is a solution to this problem if record density is sufficient and if relevant environmental data are available. Topographic, climatic and landcover layers with high resolution (1 km²) and quality are only now available on continental scales.

Geo-referenced point localities of bats (Chiroptera) were subjected to GARP-modelling (**G**enetic **A**lgorithm for **R**ule-set **P**roduction) based on 25 environmental layers (6 land cover, 4 topography, 1 hydrology, 14 climatology). Potential distribution of bats was modelled in relation to record density: 1) throughout West Africa, 2) West & North Africa, and 3) sub-Saharan Africa. Most species show clear relations with vegetation zones and / or topography. In a few cases, biogeographic distribution limits were not adequately reflected in the model output but subsequently modified in the post-production of the data.

Species richness of bats in West Africa shows a conspicuous unimodal pattern, where diversity peaks in the forest-savanna ecotone north of the rainforest zone. Habitat heterogeneity (both vegetation and topography) are the most important drivers of bat diversity. Furthermore, we analysed the spatial distribution of **Red List-species** (IUCN 2004). Modelled centres of RL-species are found along the trans-national borders between Ivory Coast, Liberia and Guinea, in dry forests of S-Ghana, and in SE-Nigeria. Most of these RL-hotspots are not covered by the current network of protected areas (IUCN I-VI) and constitute critical gap areas that call for international conservation strategies to preserve these priority areas. Our approach aims to set conservation priorities for West Africa and to provide policy makers from national to international levels with the necessary background to efficiently manage limited conservation funds.

P7.13

AN INDICATOR TAXON FOR BIODIVERSITY AND CONSERVATION STUDIES IN TROPICAL FORESTS: THE SCARABEINAE (DUNG BEETLES)

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There is an increasing alteration of ecosystems by human activities. Tropical forests are under the greatest threat and the resulting loss of biodiversity is a key issue of conservation. We need a reliable quantitative assessment of biodiversity to monitor natural communities in time and to select conservation areas. Vertebrates have been mostly chosen as animal indicators for the analysis of biodiversity in tropical forests. However, insects were increasingly used because of their great species richness, abundance and tight relation with environment. The dung beetles of the subfamily Scarabaeinae are well represented in the tropical region; they form a taxonomically and functionally well defined guild with a large geographic distribution. Local assemblages are easy to sample with standardised methods. They are involved in soil nutrient cycling and structure, vertebrate parasites control and secondary seed dispersal. Here are presented the effects of forest fragmentation (inundated forest) and distance from natural and man-created edges in a forest dung beetles assemblage in French Guiana. Reduced species richness and abundance were observed in the smaller forest islands and in proximity to edges. Only a small number of forest species seemed not to be affected by adverse conditions along edges. As in recent studies, rainforest dung beetles appeared specialised within a narrow habitat and showed a high ecological sensitivity to environmental changes.

P12.20

Speciation in obligate plant-ants of the genus *Crematogaster*: The role of host-identity versus host-distribution

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The *Crematogaster* (subgenus *Decacrema*) –*Macaranga* (Euphorbiaceae) association in SE Asia is one of the most species-rich ant-plant associations worldwide with both groups showing considerable radiation. *Macaranga* hosts are distributed in patches in disturbed sites as well as gaps in primary forest and along river edges. Non-random association patterns of ants and plants are observed in spite of the often sympatric occurrence of several host-plant species within a patch. Thus, speciation processes in the ant-partner may be driven either by ecological speciation via adaptation towards alternative host species, by spatial patterns of host distribution or both factors –selection and drift- in concert. The combined effects of spatially heterogeneous populations of *Macaranga* hosts, the limited dispersal of the ants and different selection pressures exerted by alternative hosts in allopatric habitat patches may enhance diversification processes within obligate plant-ant species, leading to ant populations that are highly sub-structured on small geographic scales.

By comparing ant-species with a similar geographic distribution but a) a narrow host-plant range (one host only) and b) a broad host plant range (up to three different hosts per patch) we are able to differentiate between the influence of host identity versus host distribution. We are analysing genetic variability of ant populations in naturally occurring host patches in primary as well as secondary forest. Population structure of the ants is examined using mtDNA-haplotypes as well as microsatellites.

P5.1

Floristic zonation, structure and plant diversity patterns within a Caribbean mangrove forest on the Bay Island of Utila (Honduras)

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Our poster presents results of a study looking for the floristic zonation, vegetation structure and plant diversity patterns across a typical Caribbean mangrove forest on the Bay Island of Utila (Honduras). Covering more than 1/3 of the total island surface (42km²), Utila hosts one of the largest, contiguous and most unique mangroves in the Caribbean. These tropical wet forests are home to the narrow endemic iguana *Ctenosaura bakeri*. Despite occasional iguana-hunting by the native population, anthropogenic disturbances are still rather low due to the inland terrain's low land-use potential. While currently still in near-natural condition, Utila's tropical coastal forests are at high risk, as tourism on the island rapidly grows and large stretches of the still undeveloped northern coast of the island are already sold and will be developed for tourism in the nearest future.

Even though descriptive studies on mangrove zonation exist in immense number, quantitative data on within-swamp distribution of plant species are relatively rare, leaving important questions concerning ecology and stand dynamics of these forests unresolved. With our study we seek to contribute some new aspects about the mangrove structure on Utila and the Caribbean mangroves in general. Stratified vegetation sampling with 10 cm resolution (including species composition, total ground cover and abundance) along a 1,200 meter transect allows for quantitative and multivariate analyses. Beside the search for zonation of vegetation within the mangrove forest as a result of micro-topography and its influence on environmental factors such as salinity, tidal flooding, etc., structural changes (i.e. stratification of stands) along the transect are shown. Finally, plant diversity patterns within the mangrove swamp are discussed.

Compared to other ecosystems of the tropics, mangroves - especially in the new world - are regularly considered as rather simple and species-poor units (at least concerning vascular plants). Within these mangrove forests, however, the apparent zonation results in sudden changes in species number and vegetation structure, creating a rather diverse ecosystem after all.

P7.1

Species sensitivity to fragmentation: bats on land-bridge islands in Gatun Lake, Panama

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Species manage to survive in fragmented landscapes differently. Which traits cause these differences – what characteristics render some species more vulnerable to fragmentation than others? We addressed this question using distribution data collected on 23 species of bats to compare hypotheses on the causes of interspecific differences in sensitivity to habitat alteration. Bats were captured with mistnets over a 2 year period on 11 forested land-bridge islands in Lago Gatún, Panamá, and on the adjacent mainland. The following six explanatory variables were derived based on a variety of available literature sources and/or the capture data and used to construct a set of candidate models: (1) body size, (2) natural abundance, (3) trophic niche breadth, (4) vertical niche, (5) mobility, (6) edge-sensitivity. These variables were used separately and in combination for model fitting. The association between species prevalence, i.e. the proportion of islands occupied, and these predictor variables was assessed with generalized linear models (GLMs; logistic regression). Model selection was performed using information-theoretic model selection methods based on Akaike's Information Criterion. In a preliminary analysis, models incorporating natural abundance in continuous forest and edge-sensitivity (an index representing the proportion of bats captured in mainland interior sites compared to mainland forest edge sites) received the strongest support, while all other traits were much inferior predictors of fragmentation sensitivity. These findings suggest that, in the species and landscape examined, some traits seem less important than they are generally considered. In some cases this may be due to potentially conflicting effects of traits like mobility (larger home range size can indicate not only greater dispersal ability but also greater area requirements) or body size. The hypothesis that food specialists are more vulnerable was not supported, probably because dietary specialization in bats is generally low and there was too little variation in this attribute among the species included in this study. Our results stress the importance of edge-sensitivity. Since our study islands were relatively small many species have to include several islands in their home range. Forest-interior species are typically very reluctant to do so and hence constitute an exceptionally vulnerable group. This study highlights the importance of analyzing different systems in detail, because responses differ substantially not only among species but also among broader taxonomic groups, in order to further our understanding of the ecological effects of habitat fragmentation and to develop effective conservation concepts.

P12.6

Plant water relations as indicators and regulators of bush encroachment in Awash National Park, central Ethiopia

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The Acacia savanna woodland in Awash National Park, in central Ethiopia, has changed in habitat types recently as a consequence of unnatural abundance of *Acacia oerfota* Schweinf. and *Acacia mellifera* Benth., among the indigenous species. To quantify the competitive ability of the encroachers, plant water potential and osmotic potential of nine common co-occurring species were measured in the field during midday and predawn in the dry season. Water and osmotic potentials were measured with a pressure chamber and a cryoscopic method, respectively. The measurements indicate the water availability and solute concentration of both species and their sites. We found that the encroacher species had higher water potential (predawn -1.38 MPa) and low osmotic values (predawn -2.56 MPa to -2.05 MPa). The joint effect of overgrazing, drought and fire, which might have been caused for high solute concentration of the soil is an important limiting factor that favours expansion of species with low osmotic value. By measuring the plant water and osmotic potentials of the dominant species, it was possible to quantify the expansion capability of the species, monitor the present site condition and predict the direction of future changes.

P7.17

Epiphytic biomass on trees isolated in pastures in montane southern Ecuador

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Due to deforestation pastures expand rapidly in montane southern Ecuador. These pastures typically feature remnant trees. The objective of this study was to assess changes in amount and composition of epiphytic biomass after the isolation of remnant trees.

Field work was carried out around the Reserva Biológica San Francisco, at 2000m a.s.l. on the eastern slope of the Andes. Mean annual precipitation is 2200 mm. 20 isolated remnant trees (IRTs) and forest trees (FTs) respectively were climbed. Samples were taken randomly in eight different categories, five referring to branch diameter and three to height on the trunk of each tree. The epiphytic biomass was removed and subsequently divided into lichens, bryophytes, ferns, flowering plants and dead organic matter (DOM), then dried and weighted. Using data loggers and hemispheric photography, differences in microclimate were assessed.

The results showed that host trees in the undisturbed primary forest carried significantly more biomass than the IRTs, especially in bryophytes and ferns. On IRTs the highest biomass was found on branches with a diameter of 10-20 cm, least in the lower stem zone.

Comparison of microclimate data of both habitat types showed that in the forest temperature and humidity are rather even, whereas on the pastures there is a strong diurnal change with peak air temperatures and humidity lows at early afternoon. Relative differences in microclimate were highest in the lower stratum, which correlates with the losses in biomass of drought sensitive taxa in the lower stem zone on IRTs.

P11.6

Rainfall and throughfall nutrient fluxes in a palm-rich open tropical rainforest (Rondônia, Brazil)

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The element flux in throughfall is an important component of tropical rainforest nutrient cycles. For nutrients leaving the ecosystem by overland flow, which is usually not generated right in the beginning of events, it becomes important to know at what stage of an event element fluxes in throughfall are highest. Usually nutrient cycling by throughfall is analyzed on weekly or monthly basis and less frequently on event basis.

Our study investigated within-event dynamics of nutrient fluxes in rainfall and throughfall in a palm-rich open tropical rainforest in Rondônia, Brazil. During the rainy season of 2004/2005 we sampled 42 and 35 rainfall events on event and on within event basis, respectively. Net throughfall fluxes for several events were found to be negative for H^+ , Ca^{2+} , NH_4^+ and NO_2^- and positive for K^+ , Na^+ , Mg^{2+} , Cl^- , NO_3^- , SO_4^{2-} , DOC and DIC .

The within event sampling enabled us to determine the relative importance of dry deposition and canopy leaching. It can be observed, that the dry deposition is washed of the canopy during the "first flush". After the first flush, events are characterized by relative constant fluxes which we attribute to leaching processes within the canopy. This method of within event sampling was compared to a method of multiple regression analysis commonly used to separate dry and wet deposition proportions. Throughfall minus rainfall deposition (net deposition) as the dependent variable was regressed over antecedent dry period (dry-gap) and event size for each ion. The uneven distribution of residuals led us to treat collector number as a covariate.

Our findings demonstrate that nutrient fluxes in throughfall are highest in the beginning of rainfall events due to the removal of dry deposition by washing and decline after the first flush to a constant flux, a fact that deserves consideration in nutrient cycling problems.

P8.6

Knowledge-based monitoring and evaluation system of subtle changes in land use

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This project develops a monitoring and evaluation (M&E) system to assess the conservation status of natural forest. The system sets up the basis for a prospective decision support system for local adapted management and conservation strategies. The M&E system is fitted to the forest located in the influence area of the gas-pipeline San Miguel-Cuiabá in East Bolivia. The Chiquitano dry forest is an ecosystem still close to natural conditions; however in December 2000 an underground pipeline came into operation to export gas to Brazil. The underground pipeline cut through the forest and its direct impact on the vegetation cover was discernible. Less obvious are its indirect impacts, which are related to: (a) a village level compensation program, and (b) the use of the pipeline's corridor as route of access into new forest areas, especially for hunting and logging activities. The combination of the gas pipeline issues with aspects of the endogenous land use forces a joined M&E program.

The M&E system was built using a combination of conventional and novel methods in six interactive phases. Both scientific knowledge and local issues of land use were integrated using knowledge engineering, fuzzy logic, and geographic information system (GIS) techniques. The M&E system evaluates land cover information derived from remote sensing data and land use data obtained from village-level surveys. Four components make up the system:

- (a) Final set of conceptual factors and indicators,
- (b) Fuzzy logic knowledge-based models for spatial evaluation,
- (c) Validation of the system and baseline M&E, and
- (d) Brief M&E protocol.

The results provide a structured program for evaluating subtle changes in the intensity of land use, which affect the features of land cover. These changes not modify the overall category of land cover, but are decisive regarding the conservation status of ecosystems. The M&E system is an understandable and logic output that considers and documents lessons learned on the field, which facilitate a successfully acceptability and implementation by the end-users. The modularity of the knowledge-based models enables: (a) a separate assessment of the level of pressure from each factor, identifying which human activity is causing higher impact on the ecosystem; and (b) its adaptation or expansion if (e.g.) new human activities take place within the research area. Moreover, single parts of each model can be transferred to other models in order to evaluate other forest ecosystems exposed to similar human pressures.

P12.16

The bias of detection methods for Namibian soil fungi

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Gellap Ost and Nabaos are adjacent sites in the Nama Karoo of southern Namibia. The sites are under strongly different land management, resulting in different plant cover. Gellap Ost supports copious growth of grasses, whereas shrubs are the dominant vegetation in Nabaos.

Soil borne microfungi at the two sites were monitored using two different approaches: on one hand, they were cultivated from the soil and identified in pure culture. On the other hand, DNA was isolated from the soil and the resulting sequences were assigned to species using comparisons to the NCBI database.

The most frequently occurring sequence in Gellap Ost belonged to a Zygomycete, which was absent from the sequences gained from Nabaos. In cultures gained from Nabaos, the Zygomycete was found, but with a distinctly lower frequency than in Gellap Ost. Since no Chytridiomycetes were found in culture, the high frequency of sequences from Chytridiomycetes in Gellap Ost was an unexpected finding.

On the other hand, cultures of *Fusarium* spp. were frequently isolated, but corresponding sequences are missing. *Aspergillus* spp. are also frequent among the cultures, but underrepresented in the sequences.

Both Zygomycetes and Chytridiomycetes are involved in early stages of plant litter decomposition. Due to overutilisation, organic litter is virtually absent from Nabaos, therefore we interpret the lack of these groups in Nabaos as a consequence of overutilisation.

Overutilisation of plant resources in Nabaos therefore changes the ecologically important process of organic litter degradation.

P10.2

Calculating spatial distribution of landcover and LAI from remote sensing data for modelling purposes – An example of using a database of a heterogenous research group in a tropical mountain rainforest, South Ecuador

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The research project "Functionality in a Tropical Mountain Rainforest: Diversity, Dynamic Processes and Utilization Potentials under Ecosystem Perspectives" funded by the German Research Council is a combined effort of more than 30 individual working groups. A very broad spectrum of scientific disciplines is covered and a sophisticated internet driven database is designed to share the results of the working groups. The database is implemented using common open source software. The modular concept and the complex relational structure of the database guarantee easy and quick usage and updateability as new datasets are produced by the research group. Data provided by various working groups can be used to create new datasets and is shown for the creation of a landcover classification and the spatial distribution of leaf area index (LAI).

LANDSAT ETM+ data is used in combination with aerial images, a digital elevation model (DEM), in situ vegetation surveys and expert knowledge to create a vegetation and landcover classification. The raw LANDSAT data is orthogeographically, topographically and atmospherically corrected. Training sites for a supervised classification are outlined using high resolution aerial images and expert knowledge. Derived topographic features (such as slope angle) from a DEM are also used for the classification. The output gives a detailed landcover map of the whole investigation area.

LAI is estimated by calculating a regression function between the Normalized Difference Vegetation Index (NDVI) and in situ measurements of LAI with hemispherical photos. The produced LAI map with a spatial resolution of 30 m represents a much better result as other sources like the MODIS LAI product, which is a global product with obvious mismatches in the underlying landcover classification scheme.

This derived new information is used to set up and feed a Soil-Vegetation-Atmosphere-Transfer (SVAT) scheme. The landcover product is used to calculate the abundance of Plant Functional Types (PFTs) in the desired resolution of the modelling approach. The LAI is needed for each PFT to run the biophysical interactions of the model. First results of a modelrun with simplified climatology input data is shown.

The paper shows how the database of the research group can be used to create new datasets and provides all input values needed for a sophisticated land modelling approach, especially terrestrial point measurements to validate and calibrate remote sensing data.

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P11.3

Pressurized gas transport in Amazonian floodplain trees

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Trees of Central Amazonian white water floodplain forests are highly adapted to long-term flooding and to oxygen shortage in the soil and roots. Water logging lasts several months, and the improvement of oxygen transport to the roots by pressurized gas transport, known for some tree species of the temperate zone, is one specific adaptation to flooding. To evaluate its significance, gas transport measurements were carried out under experimental conditions with saplings of five Amazonian tree species, *Pseudobombax munguba* (Mart. & Zucc) Dugand (Bombacaceae), *Crateva benthami* Eichl. in Mart. (Capparidaceae), *Vitex cymosa* Benth. (Verbenaceae), *Cecropia latiloba* Miq. (Cecropiaceae) and *Nectandra amazonum* Nees (Lauraceae). All are characteristic species of the high- to mid-level tree communities along the flood level gradient. Polarographical measurements of oxygen exchange between root and rhizosphere showed that internal aeration of the roots was improved under conditions of pressurized gas transport. Tracer gas measurements using sulphur hexafluoride (SF₆) showed gas permeability of transport pathways between stem base and roots. Basing on the data, we suppose that pressurized gas transport significantly contributes to internal aeration of roots in Amazonian floodplain saplings growing on the higher levels in the flooding gradient, with low water columns, and is an important adaptation for establishment in these temporarily inundated habitats also in the weeks of rising and lowering water levels.

P9.2

Simulating the impact of edge effects and local recruitment conditions on forest dynamics in fragments at the Plateau of São Paulo

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After two centuries of deforestation on the Plateau of São Paulo, Brazil, forest regrowth is mainly restricted to fragments that were not used for agriculture, with the exception of one nature reserve (Morro Grande Reserve, ~10,000 ha). The effect of the different regeneration conditions in the fragments and the continuous forest on the vegetation dynamics were investigated by a simulation model. Therefore we applied and extended, as part of the German Brazilian research program BioCAPSP, the forest growth model FORMIND. This individual-oriented and process-oriented model simulates the spatio-temporal dynamics of forest stands. The model describes forest dynamics as a mosaic of interacting forest patches, 20 m × 20 m in size. Within these patches trees compete for light and space following the gap model approach. To cope with the high number of species, the model simulates the dynamics of plant functional types (PFT) instead of single species. The PFT's differ in their shade tolerance (intolerant, intermediate, and tolerant) and their maximum potential height. We will present and discuss simulated long term dynamics of biomasses of the different PFT's. In fragments the long term total biomass is lower and the intermediate shade tolerant PFT's are more dominant compared to the continuous forest. Especially we will focus in this presentation on the impact of reduced seed rain and the increasing importance of local recruitment dynamics in isolated fragments.

P12.11

First insights into the genetic population structure of South East Asian ant-plants of the genus *Macaranga* (Euphorbiaceae)

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Knowledge of the ecology and population dynamics of pioneer species is critical for understanding regeneration processes of tropical rain forests, and is therefore essential for conservation management. The genus *Macaranga* (Euphorbiaceae) comprises some of the most important pioneer tree species of lowland dipterocarp forests in South East Asia. In primary forest being restricted to forest gaps, *Macaranga* has become one of the most conspicuous trees in logged areas, as a consequence of the enormous increase of disturbed habitats. The great biological success of *Macaranga* is largely attributable to its close relationship with ants, which comprises the full range from occasional and facultative to highly specific. About 30 *Macaranga* species in South East Asia are myrmecophytes, i.e. they provide food and nesting space in exchange for protection by their ant partners. In these obligate relationships ants and plants are not able to survive without each other. Despite their abundance, to date nothing is known about the factors structuring genetic diversity in these dioecious pioneer species. We used nuclear microsatellite markers to compare patterns of population differentiation and genetic variability between two closely related *Macaranga* species from different sites in Sabah and East Kalimantan, Borneo. Whereas *M. gigantea* is not colonized by ants, *M. pearsonii* is an obligate myrmecophyte. Differentiation among populations was generally low but increased with geographical distance. F_{ST} values among populations reached maximum values of 0.35 for *M. gigantea* and 0.27 for *M. pearsonii* over geographic distances of 600 to 800 km. No significant differences were found in population genetic parameters of the two species, suggesting that obligate myrmecophytism as such had no major influence on differentiation processes. Our data suggest that gene flow in *Macaranga* had been comparatively high before anthropogenic fragmentation of the forests. To investigate the effects of different regimes of anthropogenic disturbance on population dynamic processes, we have initiated comparative studies of genetic variability in *Macaranga* populations from primary forest versus different types of secondary vegetation.

P8.4

Impact of forest fragmentation on phenological events in tree communities of the Mata Atlântica in the state of São Paulo, southeastern Brazil.

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The diversity of species and habitats can lead to variations in phenological patterns of vegetation. This can be expressed in a variation of species composition or in variation of the phenological behavior of the same species in different microhabitats.

The study aims at characterizing the impact of forest fragmentation on phenological events in tree communities at the plateau of Ibiúna, southeastern Brazil. Therefore, this study intends to identify the occurrence of phenophases like flowering, fruiting, leaf fall and leaf flushing in forest fragments and continuous areas, relating i) the fragment size and phenology; ii) the seasonality of phenological events; iii) the influence of abiotic factors and iv) the tree selection for feeding by birds. The study is done in a fragmented area around Jurupará Park (São Paulo). To attain these objectives 20 areas with different amount of continuous forest and forest fragments are studied. Four areas inside Jurupará Park are studied as control. A monthly registration of phenophases and a estimation of the intensity of the events are performed. The intensity of the events is estimated individually in accordance to the half-quantitative scale of FOURNIER. The characterization of the vegetation (distribution and stratification) is done during the observation periods. To identify frugivory of birds two methods will be used: observation and census of fruiting and collection of fecal samples and seed samples. This information will contribute to the understanding of effects of habitat fragmentation on trees and birds and will therefore be important for the selection of conservations areas in the Mata Atlântica.

P12.18

Altitudinal and environmental gradients in species composition, stand structure and soil characteristics of a tropical montane forest in the *Bosque de Protección Alto Mayo*, Perú

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The *Bosque de Protección Alto Mayo*, a protected national forest, covers the headwaters of the Alto Mayo River in the northeastern branch of the Peruvian Cordillera Oriental. Due to its accidental relief the *Bosque de Protección Alto Mayo* remained nearly undisturbed during the rapid colonization of the Alto Mayo valley by settlers from the Andes in the last fifty years. In spite of its importance of preserving this water generating carst area maintaining the highly populated Alto Mayo basin the vegetation of the *Bosque de Protección Alto Mayo* is only poorly studied and existing studies are confined to animal and plant lists (DILLON, 2004; ROJAS, 2003).

This study investigates the upper montane forests of the Yuracyacu River - a tributary to the river Alto Mayo - between 2300 and the tree line (3200m a.s.l.) which is depressed by anthropogenic influences like extensive cattle grazing and fire.

27 plots (20 x 20m) were established at four elevation levels: at 2300, 2600, 2900 and 3200m a.s.l. Structural forest features like diameter at breast height, tree height and stem density as well as species composition were recorded for all trees with a DBH > 10 cm according to the relascope method of Bitterlich. Additionally soil characteristics were recorded for each plot. The altitudinal gradient in the study area was superimposed by varying bedrock geology ranging from mesozoic fine sandstones over siltstones to limestone.

We analysed the dependence of the structural, floristic and soil features on altitude, geomorphologic position and bedrock geology. Preliminary results showed that the soils of the studied area are generally well developed and show a thick organic layer; thickness ranging from 20 to 40 cm. Gleyic features are common in the lower plots while podzolic features are characteristic for the upper plots.

Maximum tree height and canopy height decrease with altitude spanning from 22 m at 2300m to 14m at 3200m a.s.l. Basal area and stem density also suggest a decrease with altitude but vary highly due to geological substrate and slope position.

Prevalent tree families in the studied montane forest are *Cunoniaceae*, *Cyathaceae*, *Myrsinaceae*, and *Melastomataceae* which dominate the whole altitude range. Diversity of tree species on both family and species level declines with increasing altitude. Common tropical lowland families like *Moraceae* diminish and are absent in the 3200m a.s.l. plots.

P6.7

Diversity and refugee function for indigenous fauna and flora in anthropogenic influenced habitats in tropical regions: A case study on the Chagga Home Gardens on Mt. Kilimanjaro, Tanzania

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The former sub-montane forests of the southern and eastern slopes of Kilimanjaro are today substituted by small coffee-banana plantations, the so-called Chagga home gardens. Since these cultivated fields still have the structure of a forest, they are a potential refuge for forest plants but also for animals, which is investigated in this study for grasshoppers, locusts and katydids (Saltatoria). 62 permanent plots (usually 0.1 ha) were established between 1996 and 2004 in the Chagga home gardens along transects from 800-1800 m and compared with the other vegetation formations on this volcano on basis of over 1400 plots following the method of Braun-Blanquet. Saltatoria were recorded by sight, net-sweeping, and shaking of trees.

Saltatoria: Due to the forest structure of the Chagga home gardens with a tree, shrub and herb layer, more than half of the 52 recorded species are forest species, whilst the remainder originate from open habitats. Moreover, the Chagga home gardens harbour >70 per cent of all forest species and >50% of the endemic species of Mount Kilimanjaro. Most endemics in the plantations originate from sub-montane habitats, and contribute 72% of the total number of sub-montane endemics found in the region. More than half of all endemics from the montane zone are also found in the Chagga home gardens.

Flora: The Chagga home gardens maintain a high biodiversity with about 520 vascular plant species including over 400 non-cultivated plants. Most species (194) are forest species, followed by 128 ruderal species, including 41 neophytes. Beside relicts of the former forest cover, which lost most of their former habitats, there are on the other hand (apophytic) forest species, which were directly or indirectly favoured by the land use of the Chagga people. Therefore, the Chagga home gardens act as an important refuge for both generalist forest species and endemic fauna. In recent years new coffee varieties have been introduced to the gardens that are less shade demanding, and tree removal may impinge on the indigenous Saltatoria fauna and endanger this effective and sustainable system.

P13.3

Altitudinal zonation and diversity patterns of the forests of Mt. Kilimanjaro

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Based on the analysis of 600 vegetation plots using the method of Braun-Blanquet (1964) the altitudinal distribution of trees, shrubs, epiphytes, lianas and herbs along a transect of 2400 m was studied in the montane (cloud) forests of Kilimanjaro. With unidimensionally constraint clustering significant major discontinuities were observed occurring in parallel in the different strata at about 1200 m, 1800 m, 2500 m and 3000 m. Over 1200 species representing about half of the whole vascular flora on Mt. Kilimanjaro were found in the studied plots, making the forest belt the most important habitat with respect to plant diversity on the mountain. Species numbers of the different forest strata peak in different altitudes: whereas epiphytes and herbs have their maximum at mid-altitudes, the other strata show a declining diversity trend with altitude. Precipitation (especially in case of epiphytes), minimum temperature (in particular the occurrence of frost) and variety of habitats are key factors behind the observed diversity patterns. The contrary results of many transect studies in respect of the continuity of the change in floristic composition and diversity appears to be caused in many cases by different sampling methods.

P6.10

Patterns of Ant Diversity and Stemborer Infection on Maize Fields in the Vicinity of a Tropical Rainforest in Western Kenya

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The objectives of this study were to analyze (1) patterns of ant diversity and abundance in a human-dominated landscape in the vicinity of a tropical forest remnant, (2) to determine which habitat variables influence these patterns and (3) to test if the same variables show a relationship with the maize pest insects and if ants function as biological control agents of stemborer larvae (Insecta: Lepidoptera). The study was conducted in the agricultural area around Kakamega Forest, Western Kenya, where 24 maize fields have been chosen as study sites. For every field site the following variables have been measured: ant diversity, ant abundance, density of stemborer-infected plants, distance to the next forest, field size, vegetation at field margins, undergrowth inside field, maize plant density. Two sampling methods have been employed to study the ant fauna: i.e. pitfall trapping and oil baiting. These techniques seem to be suitable for a satisfactory biodiversity inventory of ground living ants in maize fields with an additional look on hypogaeic ant species. In total 44 ant species of 21 genera representing 7 subfamilies could be identified. Stepwise multiple regressions revealed that the diversity of ants was significantly higher at field margins showing a structural-rich vegetation and on fields with lower maize plant density. Within maize fields we found a diversity gradient from a more diverse field edge to a species poor field centre. The abundance of ants was significantly higher in maize fields more distant to the next forest. The density of stemborer-infected plants was significantly positively correlated with the distance to the next forest and size of the maize field, possibly due to higher abundances of parasites or predators of stemborer larvae near forests and complex field margins. However, ant diversity and abundance had no significant impact on infection rates. The results of our study show that traditional subsistence farming which often retains complex natural edge structures can maintain a relative high ant diversity. Modifications of farming practises towards modern intensive managed agricultural systems can lead to a loss of a good part of the ant diversity and to an increased stemborer infection.

P10.8

Severe *Streptococcus* infection in a free-ranging, large carnivore, the spotted hyena (*Crocuta crocuta*)

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Increasing global movement of humans and animals has precipitated a rise in the emergence of novel pathogens in wildlife. Currently the dynamics of such infections are poorly understood and their impact on host populations is rarely quantified. Infections with virulent streptococci cause severe and economically important diseases in livestock and humans, but are rarely reported in wildlife. We report *Streptococcus* infection in spotted hyenas (*Crocuta crocuta*) in the Ngorongoro Crater, Tanzania. Hyenas with active infection expressed clinical signs including swollen mandibular lymph nodes followed by the formation of abscesses, respiratory distress, mild ataxia, and lethargy, and 12.5% of these hyenas died. Internal organs of one hyena that died revealed pathologies indicative of an acute bacterial infection. Phenotypic and molecular genetic analyses of the likely causative agent of infection revealed a *Streptococcus* with a high level of homology to *S. equi* subsp. *ruminatorum*, a subspecies of *S. equi* recently described in livestock with mastitis in Spain. The same bacterium was also isolated from hyenas without clinical signs, suggesting that hyenas may harbour 'carriers' of this bacterium, and from a sympatric Burchell's zebra (*Equus burchelli*), a herbivore species often consumed by hyenas. High genetic similarity between the hyena and zebra isolates suggested inter-specific transmission, possibly when hyenas consume infected zebra carcasses. Prevalence of clinical cases in the hyena population indicated an outbreak between September 2002 and February 2003 that affected at least five of eight social groups resident on the Crater floor. Most clinical cases occurred after a substantial increase in group and total population sizes. The pattern of symptomatic cases within groups and in different age-sex classes indicated that nutritional stress may increase susceptibility to active infection. The outbreak was concurrent with an increase in yearly mortality rate in the population of 6.6%, resulting in a halt in the yearly growth of the population apparent in all previous study years, and a short-term decline in the size of the population.

P8.7

Long-term effects of a fire event on local plant diversity in an Amazon lowland floodplain forest

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Large and small-scale patchiness of forest areas has been identified in many tropical rain forests, and reasons to explain it are manifold. Among them, differences in climate and soil, as well as disturbance events such as hang slides, hurricanes, and fire events are best known. In lowland Amazonia strong winds and fire are the main disturbance factors and can cause huge gap areas temporarily providing growth conditions for pioneer species. Common and well documented are anthropogenic fires, causing significantly altered environmental conditions for plant growth. Nevertheless, the long-term effect of such a fire event on tree species composition and diversity has not been analysed in depth.

I have investigated this effect in a lowland floodplain forest in north-eastern Amazonia (S-Venezuela). The study site (3°10' N, 65°40' W, 104 m NN) is situated next to the Rio Surumoni, a black-water tributary of the upper Orinoco, southern Venezuela. Parts of it have been subjected to anthropogenic or natural fire events ca. 80 to 150 years ago.

Tree species composition (all trees with dbh ≥ 1 cm) has been recorded in 10 plots (20 by 20m). To analyse the past disturbance effect on tree diversity and species composition, two plots without evidence for a past fire event (=no charcoal in soil), and three plots with less charcoal have been compared with five plots estimated to be clearly disturbed (charcoal in soil and mono-dominant tree species).

Overall α -diversity of tree species is only slightly reduced in disturbed plots. This effect is much more pronounced in trees with dbh ≥ 10 cm. In trees with dbh ≤ 10 cm differences are not pronounced.

Disturbed plots are different in life forms and in species composition (β -diversity) compared to less and undisturbed plots.

α -diversity of under storey plants is slightly higher in disturbed plots.

Disturbance by fire events can cause notable and long lasting effects on species diversity and composition, and hence, are certainly one reason to explain small-scale patchiness of Amazon rainforest.

P7.2

Ecophysiology of Carbon Uptake and Water Use by the Palm *Mauritia flexuosa* L.

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The palm *Mauritia flexuosa* is the most widespread and economically important palm of South America. The edaphic and climatic habitat requirements of this important palm species are not well known. Scattered information exists on pedology and structure of Aguajales but virtually no information is available on the eco-physiological controls of the carbon and water cycles.

During this study we determine the assimilation rates and water uptake patterns of *Mauritia* under different developmental stages and for different conditions of site climate and flooding regime. The study is being conducted in an Aguajal near the Los Amigos Research Center in Madre de Dios, Peru. The research objects are seedlings, saplings and mature palm individuals within the Aguajal along a water logging gradient.

The apparent gas exchange and response curves for leaf photosynthesis, light and CO₂ concentration were determined during a first field campaign at the middle of the dry season in August 2005. Further measurements will be done at the peak of the rainy season (February 2006), and the beginning of the dry season (June 2006).

Transpiration, soil moisture and site climate are being monitored since August 2005 at three sites along a water logging gradient for an entire seasonal cycle of one year in order to cover the physiological responses of *Mauritia* during changes from non-flooded to flooded conditions and for growing and dormant seasons.

The results of this work will establish the basis for a study on the physiological response of Aguajales to climate variation in order to predict ecosystem dynamics driven by global change. The understanding of the eco-physiology of carbon uptake and water use by *Mauritia* will allow to model and evaluate the sensitivity of Aguajales to scenarios of environmental change. It will allow to base predictions of the effects of global changes on these amazing Amazonian biomes on a sound eco-physiological base.

P1.4

Establishing of an amphibian bio-indicator system and capacity building in West Africa, as basis for a sustainable biodiversity management - Past and present work

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In order to preserve the highly threatened biodiversity of West Africa, bio-indicator systems are urgently needed. Amphibians have been shown to serve this purpose very well. As a baseline, taxonomy was resolved for most West African frogs and standard methods for their assessment and monitoring have been established and implemented. We successfully tested the usefulness of an amphibian community based indicator system in lowland forests in the Tai region (Ivory Coast, pristine, selectively logged and fragmented forests). Currently we are in the process of complementing these results with studies in a savannah-forest transition zone in the Lamto Reserve (Ivory Coast) and within variously altered savannah ecosystem of the Pendjari region (Benin). An outlook to future work is given on a second poster.

P10.7

Experiences with a playback technique to monitor lions (*Panthera leo*) and spotted hyaenas (*Crocuta crocuta*) in Katavi National Park, western Tanzania

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A pilot study about lion and hyaena populations was conducted in Katavi National Park, Tanzania. The main aim was to test the feasibility of playback call-ins to assess abundance of lions and hyaenas and to analyse the sex and age structure of the lion population. A second aim was to test the most accurate field design for future monitoring efforts. The field design was established with the help of GIS software and the field work was supported using GPS navigation.

The survey was performed by using a standardised playback call-in to attract carnivores. Population estimates were derived using a mathematical model, that takes response range and response probability of lions into account. Response probability was tested during 13 experiments.

Results show that a systematic field design and a high sampling effort are essential to generate reliable population estimates. Using road transects leads to a severe overestimation of lions and an underestimation of the hyaena population.

Number of lions (>1 year) is estimated to be 185 (85- 484) for the entire National Park. This gives an estimated density of 0.043 (0.02 - 0.11) lions / km². The mean density would classify Katavi NP as an area with low to medium lion density. The sex ratio of adult lions is strongly biased towards females whereas the sex ratio of young lions is in favour of males.

Although a high sampling effort was undertaken, the confidence limits for the lion population vary considerably. This can mainly be traced back to the large variance in pride size. Though, there are indications that the mean estimate is close to the population number. Higher precision could only be achieved if the entire NP was accessible.

Hyaena population (mean: 741; 580-954) and density (0.17; 0.14-0.22 hyaenas/ km²) estimates are relatively precise and show that spotted hyaenas are likely to be the most numerous large carnivore in Katavi, outnumbering lions by the factor 4.

Using this method for monitoring should aim for at least 25% coverage of the area and should not be performed more than once per year in the same area to avoid habituation of the animals. The base line information of the monitoring indicate that the hunting quotas in adjacent hunting blocks are likely to be too high and that effects of over-hunting might even alter the lion population inside the National Park.

P6.9

Listen when you don't look: Australian flying foxes increase acoustic vigilance while sleeping under risk of predation

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Sleeping under the risk of predation is a common trade-off almost all animals have to face. While sleep is critical for regeneration, it is also dangerous as the ability to visually detect approaching predators is greatly impaired.

We hypothesized that in highly social mammals, an increase in alertness to acoustic cues may compensate for a loss of visual perception while engaging in light states of sleep. This 'napping' may have some of the benefits of sleep while animals are not as vulnerable as in deep stages of sleep, such as REM sleep. Although the role and importance of visual cues have been extensively studied, surprisingly little research has been done to date into the function of acoustic stimuli. Acoustic information can be either directly gathered from the approaching predator or from visually vigilant conspecifics. In social mammals gathering at high densities, the later is a likely functional mechanism only rudimentarily understood.

We tested our hypothesis in a mixed species colony of ~28,000 subtropical Australian flying foxes in coastal northern New South Wales, Australia. These gregarious fruit bats are roosting in large aggregations during daytime, while their main predators, multiple species of eagles, are active. Our target species was the threatened endemic grey-headed flying fox (*Pteropus poliocephalus*), at present undergoing rapid decline at about 30% per decade. Using 5 minute focal animal samples, we recorded occurrence of visual ('eyes open') and acoustic ('ears twitching') alertness to potential predator threats of N=369 flying foxes between 2002 and 2005. Samples were randomly taken through the colony to avoid spatial and temporal biases related to a potentially uneven predation threat landscape within the colony. 54.7% of animals were visually non-vigilant throughout the entire sampling period. Of the 45.3% visually vigilant in the sample, 54.1% showed acoustic alertness, while of the visually non-vigilant animals, 67.3% showed acoustic alertness. Only 33.6% of bats did not show any sign of alertness at all, neither acoustic nor visual.

Our results indicate that an increase in acoustic vigilance in a gregarious tropical mammal may compensate for a loss of visual cues whilst engaging in sleep. This mechanism may represent one of the major benefits of group formation which has been largely ignored in the study of animal behaviour to date. It may offer new approaches to understanding sociality in a tropical key stone group, and in particular provide with new insights into why highly social species are occurring in large aggregations are most vulnerable to the threat of extinction.

This research was funded at different stages by the Australian Government, Department of Education, Science and Training, through the Endeavour Program, the Friedrich Ebert Foundation (FES), and the German Academic Exchange Service (DAAD).

P6.5

Carbon pools and dissolved organic carbon fluxes in a tropical montane forest in Ecuador.

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The role of tropical montane forests for carbon storage is unknown. Our objective was to (i) determine carbon stocks and quantify carbon fluxes and (ii) to parameterise a carbon model with the purpose to test our understanding of carbon processes and use the model to calculate environmental change scenarios of the carbon cycle. We studied a tropical montane forest in Ecuador between 1900 and 2450 m above sea level on the east-exposed slope of the eastern cordillera of the north Andes in south Ecuador between the cities of Loja and Zamora. This heterogeneous forest is characterized by large carbon pools and fluxes. The litterfall ($0.9\text{-}1.0\text{ kg m}^{-2}\text{ a}^{-1}$) is similar in tropical lowland forests and greater than in other tropical montane forests, indicating a high production of biomass. Carbon stocks in the organic layer range between 1.2 and $3.3\text{ C kg}^{-1}\text{ m}^2$. The thickness of the whole organic layer ranges between 2 and 43 cm and increases with increasing altitude.

The residence times of carbon in the organic layer, determined as the quotient of their storage in the organic horizon and the annual deposition by litterfall is about 10 years.

The mean DOC concentrations are low in rainfall ($3.8\text{-}4.6\text{ mg l}^{-1}$) and increase in the order throughfall ($9.9\text{-}25\text{ mg l}^{-1}$) < lateral flow ($20\text{-}44\text{ mg l}^{-1}$) < litter leachate ($7.1\text{-}63\text{ mg l}^{-1}$). During the passage through mineral soil DOC concentration decrease continuously with increasing depth (15 cm soil depth with $7.1\text{-}15\text{ mg l}^{-1}$, 30 cm soil depth with $6.1\text{-}15\text{ mg l}^{-1}$). The mean DOC concentration in stream water ($4.0\text{-}8.4\text{ mg l}^{-1}$) is low and comparable to those in rainfall.

During storm events, when the water percolation switches from vertical water flow to rapid near-surface lateral flow DOC-fluxes are elevated.

Contributing to a better understanding of carbon cycle in tropical montane forests we plan to model the production and transport of dissolved organic carbon in the forest soil with DyDOC (**D**ynamic **D**issolved **O**rganic **C**arbon) under different land use (natural forest, experimentally managed forest and pasture).

P11.8

Consequences of low- and high-intensity land use on forest structure and woody regeneration in Ivory CoastKoulibaly, A.¹, Goetze, D.², Traoré, D.¹ & Porembski, S.²¹Dep. of Botany, University of Cocody, Abidjan, Ivory Coast²Dep. of Botany, University of Rostock, Germany

In the Guineo-Sudanian transition zone of West Africa, semi-deciduous forest islands are interspersed in savanna. Their high biodiversity is an important natural resource that nowadays is subjected to increasing land-use pressure and climate shifts.

Agriculture is preferentially carried out in the vicinity of forest islands and in their boundary zones. The practices of traditional low-intensity and recent high-intensity agriculture were studied in the drier north and the more humid center of Ivory Coast. Their effects on diversity and regeneration of semi-deciduous forests were studied along forest-savanna transects, past and present land use practices and ethnobotanic customs were interrogated with interviews among the inhabitants. They were investigated by comparison of protection areas (Comoé National Park and Lamto Reserve) with adjacent agriculturally used land with 10 inhabitants/km² (interdisciplinary BIOTA Africa program, supported by the German Federal Ministry of Education and Research).

Ordination of forest and savanna plots shows that regarding floristic composition and structure, woody vegetation is distributed in relation to soils and disturbance. Species diversity is comparatively high under low-intensity agriculture – especially in the more humid Lamto region –, but only half as high under intensive land use due to the elimination of woody species. The cash crops cashew in the Comoé region and cacao in the Lamto region are nowadays commonly planted with the field crops, leading to a repression of fallow regeneration and a decline of arable and forested land, i.e., to a decline of the traditional subsistence farming. However, the same general mode of land cultivation leads to the distinctively different changes in the plant-distribution type spectra between the both study regions.

Future land use must strictly allow for the high potential of forest regeneration and an enforced protection and connectivity of intact forests. It should integrate alternative methods on smaller agricultural surfaces which have already been developed.

P10.14

Photosynthetic Capacities and Leaf Conductances of Planted Tree Saplings and Competing Weeds in a Tropical Montane Pasture Confirm the General Decline from Pioneers to Late Successional Species

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In a tropical montane pasture (at 1800 m a.s.l. at the the Estación Científica San Francisco in South Ecuador) covered by native bracken, blackberry and the introduced grass *Setaria*, saplings of natural gap and forest tree species have been planted in order to initialize forest regrowth. In order to understand the different growth responses of the species, photosynthetic capacity and corresponding leaf conductance were studied under controlled light conditions. The results confirm highest capacities in pioneering weeds (*Rubus*, *Setaria*, *Pteridium*), followed by the early successional tree species *Heliocarpus*, declining via the mid-successional *Alnus* and *Cedrela* to a minimal capacity in the late successional *Tabebuia*. However, leaf conductances showed large variability, although they were highest in early and lowest in late species. In *Eucalyptus* they were extremely high, almost twenty times higher than in *Tabebuia*. As a consequence of high stomatal conductance *Eucalyptus* consumed much more water per leaf area than any other species, followed by blackberry. In contrast, bracken, *Setaria* and *Heliocarpus* showed moderate responses. Their water-use efficiencies were higher than in the mid-successional species *Cedrela* and *Alnus*. In the presented study photosynthetic capacities correlate positively with faster growth. Lower leaf conductances are consistent with the observed endurance of species on dryer sites.

P9.5

Evapotranspiration in a Tropical Montane Forest: Bottom-up (Xylem Sap Flow) and Top-Down (Catchment Weir) Approaches Result in Contrasting Numbers but Synergistic Conclusions

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The determination of reliable evapotranspiration rates in tropical forests is still difficult. We assessed annual evapotranspiration rates in a tropical montane forest in south Ecuador located between 1900 and 2200m a.s.l. with two alternative approaches. The “bottom-up” approach consisted of continuous measurements of sapflow on tree individuals and of microclimate, which were scaled up to plot size via plot structure. The “top-down” approach was a complete water budget of small (ca. 10 ha) catchments including quantification of incident precipitation and of surface flow (partly by direct water level measurements partly with the help of an hydrological catchment model).

The total evapotranspiration determined with the bottom-up approach was mm, that determined with the top-down approach 1281-1580 mm. Thus, the results of both approaches showed a large discrepancy. Both approaches have their specific methodological restrictions: E.g., how representative are the plots and trees chosen for the target area of up-scaling? Are the assumptions made concerning positions of sapflow sensors or water conducting features of sapwood appropriate? How exact is the estimate of water input to the catchments? Are there unrecorded water leakages of water from the ecosystem not seen in flow rates of the catchment weir?

Considering the specific errors of each approach we try to understand the sensitivity to errors in the measurement of a specific parameter and the process of up- or down-scaling. Both approaches have certain parameters in common (e.g. local climate, precipitation) therefore the observed discrepancy may help to complete missing information in the one approach by those of the other, yielding a reliable estimation of stand evapotranspiration. The coordinated research efforts of many working groups at one tropical forest stand provides a unique opportunity to improve the methodology for determining the elements of the forest water budget.

P6.2

Diversity of Testate Amoebae (Protozoa, Testacea) in Different Litter Types of a Mountain Rain Forest in Southern Ecuador

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The global diversity of protozoa is a matter of current scientific dispute. It has been suggested for microbial species, including protozoa, that "everything is everywhere" and thus the same species diversity can be found in temperate ecosystems and the tropics. Contrary for this assumption Protozoan diversity may be very locally between habitats.

To evaluate these contradictory hypotheses we investigated the species composition of testate amoebae in two different types of tree litter (*Purdiaea nutans*, *Graffenrieda emarginata*) exposed for one year at two altitudes (1850 m and 2270 m) of a mountain rain forest in southern Ecuador.

At 1850 m *Purdiaea* litter, a mixture of both litter types and *Graffenrieda* litter contained 40, 68 and 70 species of Testacea, respectively. At 2270 m species diversity was strongly reduced, litterbags with *Purdiaea*, mixed and *Graffenrieda* litter contained only 6, 17 and 19 species, respectively.

In conclusion, *Purdiaea* and *Graffenrieda* litter supported very different communities of Testacea. Only common species with cosmopolitan distribution occurred in *Purdiaea* litter, in contrast litter of *Graffenrieda* supported a high diversity of Testacea including new species with potentially restricted tropical distribution.

Our results indicate that the species distribution of Testacea in the mountain rain forest is influenced by plant litter type and differs locally, therefore contradictory hypotheses that in Protozoa "everything is everywhere".

P8.1

Feeding ecology of sympatric Cheirogaleidae (*Microcebus murinus*, *Cheirogaleus medius*, *Cheirogaleus major*) in the littoral forest of south-east Madagascar

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Madagascar is known for its extraordinary diversity of lemur species. Mechanisms that allow the coexistences of these species are still poorly known. Here feeding patterns were investigated for three small nocturnal lemur species of Cheirogaleidae *Microcebus murinus*, *Cheirogaleus medius* and *Cheirogaleus major* in a littoral forest in southeast Madagascar. During three rain seasons the food spectra of these three lemurs were described in relation to morphological and biochemical food plant characteristics. All three species are mainly frugivorous during the rain season in the littoral rain forest and fed on 68 different plants species with small- and medium-sized fruits. Fruits larger than 30 mm were avoided. Seeds of a total of 51 food plant species were swallowed and passed unharmed. Thus even the smaller lemur species play an important role in seed dispersal. There were no differences in the tree height, the sizes and the biochemical contents of fruits eaten between the three species. Thus, competition avoidance and niche separation are not based on different feeding pattern of *Microcebus murinus*, *Cheirogaleus medius* and *C. major* in a littoral forest during the rain season.

P2.5

Tropical lichens create microhabitat for mutualistic diatoms

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The filamentous green algal lichen *Coenogonium linkii* Ehrenb. represents a conspicuous species in the understorey of tropical lowland rain forests (e.g. Panama, Venezuela, Surinam, Guiana, French Guiana, Brazil). It occurs on trunks and is to a greater or lesser extent horizontal orientated. Due to this exposure, the lichen thallus receives a 2-3 fold higher irradiance in comparison to the predominantly vertical exposed lichens (Lakatos 2002). Moreover, this position allows to collect additional water by through fall besides of that by stem flow. The filamentous morphology, which is constructed by the filamentous Trentepohlia algae surrounded by four to eight hyphae of the mycobiont, allows sufficient gas exchange with the ambient air and water storage (Lakatos et al., submitted).

Studies of its structure by microscope and low temperature scanning electron microscope (LTSEM) revealed an inhabitation of diatoms in samples from Panama (Barro Colorado Island) and French-Guiana (National Park Les Nouragues). 18 diatom species out of the nine genera *Diadesmis*, *Eunotia*, *Hantzschia*, *Luticola*, *Melosira*, *Nitzschia*, *Orthoseira*, *Pinnularia*, and *Stauroneis* were determined – most dominant species inside the thallus were uncommon forms, such as six unknown *Eunotia* species (Lakatos et al. 2004). The diatoms are associated with extracellular polysaccharide of the mycobiont. A higher organic nitrogen content of 2.2% vs. 1.2 to 1.8% N dry wt⁻¹ of its crustose neighbours indicate an additional nitrogen source or reduced nitrogen loss in comparison to adjacent lichens. The enriched stable isotope composition ($\delta^{15}\text{N}$), which can be used as natural marker, is often interpreted as an indication of nitrogen recycling (Ellis et al. 2003). Thus, diatoms find a suitable microhabitat within the thallus of *Coenogonium linkii* and may mutualistically support nitrogen availability of this consortium (Lakatos et al. 2004).

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P3.5

The white crust on cuticles of fungus-growing ants: is it really symbiotic bacteria?

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R.¹

It has been recently suggested that filamentous bacteria of the genus *Pseudonocardia* (actinomycetales) together with fungus-growing ants (Attini, Formicidae) and their cultivated fungi (Agaricales: Basidiomycota) form a highly specialised tripartite mutualism (Currie et al. 1999). The symbiotic fungus, which is the main food source for the ants is parasitized by the specialised microfungus *Escovopsis* (anamorphic ascomycetes). It has been postulated that ants rear ectosymbiotic actinomycetes that suppress the growth of this parasite. The bacteria have been attributed to some whitish coating visible on the cuticle of genus specific regions of the ants' exoskeleton.

Here we provide several lines of evidence indicating that (1) the whitish coating does not correspond to actinomycetes, and (2) the reported interaction between ants and bacteria is facultative and casual rather than obligate and highly specific.

To verify the identity of the whitish coating we performed PCR reactions with extracts from the relevant exoskeleton parts of *Acromyrmex echinatior* and *Trachymyrmex zeteki* using actinomycetes specific DNA. Although all the examined cuticles were completely covered with the whitish coating, PCR products were detectable in only 32 % of 41 samples.

Furthermore actinomycetes adhered to the overall body surfaces were isolated from attine ants as well as from temperate ant species (*Lasius flavus* and *Myrmica rugulosa*) which do not reveal whitish cuticles. More than 50% of all isolates from both attine and temperate ants inhibited the growth of *Escovopsis* in plate assays, with the strongest effects in temperate bacteria. These findings suggest that the occurrence of *Escovopsis*-suppressing actinomycetes is independent from the fungus-growing habit and may be due to casual adherence of soil bacteria to any soil-dwelling arthropod.

Since the symbiotic bacteria are thought to be vertically transmitted between colonies by the founding queen, we hypothesised that bacterial communities of adjacent colonies (i.e. with a higher probability of relatedness) within a given habitat exhibit higher genetic similarity than colonies from distant habitats. Pulsed field gel electrophoresis revealed that Actinomycetes strains isolated from attine ants had a high diversity (21 strains), with most of the strains (85%) restricted to single colonies. The high colony specific composition of bacterial strains even from putatively closely related nests suggests that horizontal transmittance from a highly diverse soil pool of actinomycetes has to be considered.

To summarize, we conclude that the interaction between fungus-growing ants and actinomycetes is not as specialised as previously thought, although the true nature of the whitish crust remains questionable.

P5.2

Neither host-specific nor random: vascular epiphytes on tree species in a Panamanian lowland forest

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A possible role of host tree identity in the structuring of vascular epiphyte communities has attracted scientific attention for decades. Specifically, it has been suggested that each host tree species has a specific subset of the local species pool according to its own set of properties, e.g. physicochemical characteristics of the bark, tree architecture, or leaf phenology patterns.

Here, we present a novel, quantitative approach to this question taking advantage of a complete census of the vascular epiphyte community in 0.4 ha of undisturbed lowland forest in Panama. For three locally common host tree species (*Socratea exorrhiza*, *Marila laxiflora*, *Perebea xanthochyma*) we created null models of the expected epiphyte assemblages assuming epiphyte colonization reflected random distribution of epiphytes in the forest.

In all three tree species, abundances of the majority of epiphyte species (69 - 80%) were indistinguishable from random, while the remaining species were about equally over- or underrepresented compared to their occurrence in the entire forest plot. Permutations based on the number of colonized trees (reflecting observed spatial patchiness) yielded similar results. Finally, a third analysis (Canonical correspondence analysis) also confirmed host-specific differences in epiphyte assemblages. In spite of some very pronounced preferences of some epiphytes for particular host trees, no epiphyte was restricted to a single host. The epiphytes on a given tree species are not simply a random sample of the local species pool, but there are no indications of host specificity either.

P7.9

The floral ecology and pollination of African Marantaceae

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The Marantaceae are a pantropically distributed family of understory herbs and climbers in tropical lowland rainforests. So far about 500 species are known world wide of which around 40 species occur in Africa. The Marantaceae are one of the most derived families within the Zingiberales characterised by a specific, explosive pollination mechanism in the course of which pollen is deposited on the insect by a rapid, irreversible movement of the style. Concerning the African species almost nothing is known about their floral biology and pollination. Fieldwork was conducted in Gabon during the rainy season where most species of Marantaceae are in flower. Comparisons of the inflorescences between species show that they vary considerably in morphology and thus in the number of potential flowers. As a consequence flowering of a single inflorescence can take a few weeks up to several months depending on the species. To encourage out-crossing there are only a few flowers open per inflorescence per day and triggering of the flower is spontaneous and does not always happen at the first visit of a pollinator. As the insect normally visits all open flowers of one inflorescence in a row this prevents the pollinator to carry the pollen to the neighbouring flower. Pollination and exclosure experiments reveal that probably all species are self-compatible but that they need a pollinator to transport the pollen from the back of the style (secondary pollen presenter) onto the stigma. With reference to the range of pollinators and the nectar sugar concentration African Marantaceae species are not specialized but pollinated by a range of insects and birds. Flowers are visited regularly each day at a different frequency depending on species, weather and locality. Natural fruit set is rather low in comparison to hand pollination. This might be due to inefficiency of the pollen transmission system, low performance of selfing, lack of pollinators and damage by insect feeding. However, all species propagate vegetatively predominantly through rhizomes. All species within the "Ataenidia clade" additionally produce rhizophores in the leaf axils. *Marantochloa congensis* for instance produces few small white inconspicuous flowers, has an extremely low fruit set but an especially high percentage of rhizophores in the leaf axils and even in the inflorescences. The success of this latter strategy might be mirrored in the high speciation rate of the "congensis clade".

P9.4

Extirpation of large-seeded seedlings from the edge of a large Brazilian Atlantic forest fragment

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In this study we assessed the seedling assemblage of a large fragment of the Atlantic forest to test two hypotheses: (1) seedling abundance and richness are lower in the forest edge (0-200 m) than in forest interior (> 250 m); and (2) large-seeded seedlings (seeds > 1.5 cm) are the main group affected by edge creation. The study was carried out at the Coimbra forest— an old 3500-ha fragment surrounded by sugar cane plantations in northeast Brazil. Seedling survey was based on 200-m long transects in which 420 1-m² plots were set up per habitat and per season (dry and rainy respectively). Within the plots, all seedlings ≤ 50 cm tall, considering shrub, tree, palm and liana species, were counted and classified to morphospecies level. A total of 13,208 seedlings were recorded in the whole survey and at plot level forest edge and interior showed similar scores for both average seedling density (4.7-11.2 seedlings m⁻²) and richness (2.8-5.1 species m⁻²) irrespective of season. At community level, however, scores for total species richness in forest edge were 4.8-17.9% lower than those of forest interior depending on the estimator used. Moreover, large-seeded species accounted for 2.3-2.7% of all species recorded in forest edge yet this group reached 13.1-14.9% in forest interior. As a consequence, forest edge housed between 166-262 large-seeded seedlings per ha⁻¹, whereas forest interior housed 5,952-6,047 per ha⁻¹. Our results suggest that old forest edges hold biased and impoverished assemblages of seedlings, particularly in terms of large-seeded trees.

P12.2

Specialized pollination systems involving Cyclocephalini beetles (Scarabaeidae, Dynastinae) and aroids (Araceae) in the Northern Atlantic Rainforest of Brazil

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Araceae pollination carried out by Cyclocephalini beetles is very particular and involves seemingly one-sided evolutionary adaptations of the inflorescences to unorthodox flower visitors. Robust kettle-like floral chambers and nutritious tissues and abundant pollen are common modifications. Precise floral thermogenic cycles are also characteristic, designed to volatilize attractive odours synchronously to the activity period of the insects and provide a warm shelter and mating site inside the heated inflorescences. Few cases of this syndrome have been thoroughly investigated, none of those within the Atlantic Rainforest domain. We have approached the pollination ecology of three native sympatric Araceae from distinct tribes in search for singular and shared traits of each case, the local fauna of flower visiting Cyclocephalini and interaction specificity. *Caladium bicolor* (Caladieae), *Taccarum ulei* (Spathicarpeae) and *Philodendron acutatum* (Philodendreae) populations were studied in two adjacent municipalities of Pernambuco. UV-light traps were used to determine local Cyclocephalini fauna. Flowering was observed in two inflorescences of each species, in order to document the events of anthesis and identify the flower visitors. Temperature recordings of the spadix and ambient air during the complete flowering cycle were taken for each species in regular five minutes intervals. From the five Cyclocephalini occurring in the studied area, only *Cyclocephala celata* and *Cyclocephala latericia* were flower visitors of Araceae. Neither were previously cited as aroid pollinators. While *C. celata* were found on inflorescences of all three species, *C. latericia* only visited *T. ulei* inflorescences. All aroids exhibited total dependency of the pollinator's presence, as no infructescences developed from non-visited inflorescences. Thermogenic patterns were very similar in *P. acutatum* and *C. bicolor*, showing heat peaks on both female and male phases. *T. ulei* exhibited a single heating period during the female phase, longer lasting and more intense than that of the other two species. In all three aroids, beetles arrived at heated and odouriferous inflorescences in the early evening of the first day of anthesis, during female phase. They remained inside until the following night, when male phase was evidenced through pollen release. In the meantime, consumption of floral tissues and mating were observed. All Cyclocephalini-Araceae pollination systems bear similarities related to characteristic morphophysiological flower adaptations, which fit the behaviour of the pollinators. The obvious co-dependency leads to the assumption that well-established systems must be present along the natural distribution of the plants, likely involving distinct sets of locally abundant Cyclocephalini species.

P2.3

The unique *Purdiaea nutans* forest of southern Ecuador: abiotic characteristics and cryptogamic diversity

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Purdiaea nutans (Clethraceae) is a small tree distributed in montane forests in northern South America. In all known localities the species occurs scattered and in few individuals except in the Reserva Biológica San Francisco (RBSF), southern Ecuador, where *Purdiaea nutans* is the dominating tree in the upper montane forest between 2150 m and 2600 m on ridges with very nutrient-poor, leached soils. In the RBSF, the unusually high precipitation above 2100 m together with poor soils and unique topographic features at these elevations create extensive areas suitable for the growth of *Purdiaea nutans*. It appears that the *Purdiaea* forest of the RBSF represents an azonal, ridge-top vegetation type, not a zonal vegetation type as was formerly believed. The low and open canopy of the *Purdiaea* forest and the abiotic conditions in this forest are beneficial to the establishment of a rich flora of cryptogamic plants (ferns, bryophytes, lichens), including many rare or endemic taxa. A brief comparison of abiotic factors with cryptogamic plant diversity in terms of species richness and endemism in the *Purdiaea* forest will be presented.

P7.10

The soil food web of a tropical montane rain forest in southern Ecuador using stable isotopes (^{15}N)

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There is considerable dispute about the structure of terrestrial and aquatic food webs, i.e. the trophic relationships between the animals, plants and microflora involved. Most studies on food webs are conducted in temperate regions and few have been carried out in tropical regions. The aim of the present study was to investigate important elements of the terrestrial invertebrate food web (isopods, diplopods, beetles, mites) of a tropical mountain rain forest using stable isotopes (^{15}N). In particular, we wanted to separate phycophagous species from decomposer and predatory soil animals. This is the first detailed study of a tropical soil food web using stable isotopes. The results indicate that (1) tropical soil food webs comprise of about four trophic levels, (2) primary decomposers, i.e. litter feeders, are rare, (3) a large number of putative decomposer animals are predatory or necrophagous, (4) parthenogenetic taxa are rare and have lower ^{15}N values than sexually reproducing species. We conclude that (1) the number of trophic levels in tropical soil food webs is similar to that of temperate soils, (2) low litter quality limits the abundance and diversity of primary decomposers, (3) various putative decomposer soil animal species (especially oribatid mites) prey on other soil invertebrates, predominantly on nematodes, (4) parthenogenetic reproduction prevails in primary decomposers, perhaps because no direct co-evolutionary interactions occur between them and their food source, dead organic material. In contrast, species at higher trophic levels potentially have to co-evolve with living prey (e.g. fungi, nematodes) that can evolve defences; sexual reproduction is considered important in such antagonistic interactions (Red Queen hypothesis).

P9.1

Leaf-cutting ants in a remnant of the Atlantic forest: Disruption of forest regeneration?

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Leaf-cutting ants of the genus *Atta* are important generalist herbivores of the Neotropics, with many species showing a marked preference for early successional against shade tolerant plants. Previous studies have revealed that their enormous nest constructions (up to 200 m²) locally affect the abundance and species richness of the plant community. Moreover, leaf harvesting activities have been demonstrated to increase light intensity substantially above the nests and moderately in the surrounding foraging area. Here we evaluated whether the increased light availability at nest sites and foraging areas can reduce the proportion of shade tolerant species in a forest remnant. We hypothesized that these species present lower frequency near ant nests and in the foraging areas because of their low light requirement to develop and grow. Our study was conducted in a 3.500-ha fragment of Atlantic forest in Serra Grande (Alagoas, Brazil). To test for nest effects we selected 16 *Atta cephalotes* nests in the fragment. For each nest we established four plots: (1) above the nest, (2) at the border of the nest, (3) 5 m from the second plot, and (4) 20 m from the third plot. For the effects of foraging area we selected another 16 ant nests. Two plots were established for each nest, one inside the foraging area (treatment) and another in an ant-free area (control). In both experiments, we measured the light availability and identified all trees from 1.5 to 10 cm DBH and grouped species as shade tolerant or intolerant. The proportion of shade tolerant species was significantly higher with increasing distance from the nests and in control areas without ant foraging. Correspondingly, light intensity was lower in these latter areas. These results suggest a clear interference of leaf-cutting ant nests in the structure and species composition of plant communities. Such interference is probably due to differences in light penetration to the forest floor as a consequence of *Atta* nest constructions and leaf harvesting activities. Considering that shade tolerant species are important components of late successional stages, the increased presence of leaf-cutting ants in fragmented environments (see contribution by Wirth et al. 2003), delay the regeneration process and increase fragmentation effects.

P4.1

Marsupials in the Brazilian Atlantic Rainforest: MHC diversity in a fragmented landscape

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Degradation and fragmentation of tropical forests are considered as major threats to biodiversity, because these processes have critical impact on the survival probability of populations. The coastal Atlantic Rainforest (Mata Atlântica) of Brazil is one of the most diverse and at the same time one of the most threatened biomes in the world. As a consequence of habitat fragmentation, isolated populations with a reduced population size suffer from demographic stochasticity, genetic drift, inbreeding and the loss of genetic variation.

The genes of the MHC (Major Histocompatibility Complex) play a key role in the mammalian immune system in terms of disease resistance. Therefore this gene complex is directly relevant for the survival probability of the investigated populations. Several studies have indicated that functional attributes of the marsupial immune response differ from those of placental species and suggested differences in the genetic architecture of the MHC loci.

We studied the effects of forest fragmentation on the genetic diversity of the immune complex MHC in populations of the marsupials *Marmosops incanus* and *Gracilinanus microtarsus* in a fragmented landscape of the Brazilian Atlantic Rainforest in the state of São Paulo. Both species are common in this region and depend on forest habitats.

In contrast to studies on the laboratory breed marsupial *Monodelphis domestica*, which is considered to have little or no polymorphism at the MHC class II, we found high variability in both of the free ranging marsupial species at an MHC class II locus. In addition we found that populations in different fragments show different levels of diversity at the MHC with regard isolation, connectivity and fragment size. This study was carried out within the BMBF project Mata Atlântica (BIOCASP, Biodiversity conservation in fragmented landscapes on the Atlantic Plateau of São Paulo, Brazil), which aims to develop concepts for a sustainable use and the conservation of the biodiversity in the region of the Atlantic Rainforest in Brazil.

The study was kindly supported by the BMBF Germany.

P12.12

Influence of land-use intensity on seedlings and saplings of fodder trees in ephemeral rivers, Namibia

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Namibia is a semi-arid to arid country with only ephemeral rivers in its interior. Twelve of them are situated in the arid west of Namibia, crossing the hyper-arid Namib Desert from east to west. Surface flows are rare and only occur after sufficient rainfall in the upper catchment. Until today, these linear oases attract people since the rivers provide reliable fodder and groundwater resources. A change from a semi-nomadic lifestyle to permanent settlements and high population growth puts increasing pressure on the vulnerable resources of the ephemeral rivers. Increasing land-use intensity is threatening the riparian vegetation as well as the livelihoods of people. *Faidherbia albida* and *Acacia erioloba* are important fodder trees for wildlife and livestock along ephemeral rivers in western Namibia. This study investigates the influence of domestic herbivores on the regeneration of *F. albida* and *A. erioloba* along the Kuiseb ephemeral river. At locations with high livestock numbers, recently emerged as well as established seedlings of the two tree species were eaten to a majority by domestic herbivores. Significantly more protected *F. albida* seedlings survived (62%) for 29 weeks than unprotected ones (0%). Also for *A. erioloba* a significant difference between protected (53% alive) and unprotected (3% alive) seedlings was found. After removal of protective fences, 80% of the then 8-month-old seedlings were eaten by domestic herbivores within four weeks of exposure. The average annual growth rate of established saplings was significantly lower for *F. albida* at locations with high (15.7 cm) compared to locations with low livestock numbers (55.0 cm). *Acacia erioloba* annual sapling growth rate was 17.3 cm in areas with low and 5.9 cm at locations with high livestock density.

These results demonstrate that domestic herbivores are limiting the regeneration potential of *F. albida* and *A. erioloba* in the ephemeral rivers of the Namib Desert. Sound management strategies need to be developed in order to ensure the sustainable use of the riparian vegetation. Lowered regeneration success of *F. albida* and *A. erioloba* at present will lead to the reduced ability of local farmers to derive their livelihoods from the ephemeral river resources in the future.

P12.15

Diversity of intestinal parasite communities of three sympatric New World primate species (*Saguinus mystax*, *S. fuscicollis*, *Callicebus cupreus*) - a question of niche specification?

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Parasites are ubiquitous and can have a major impact on their hosts in terms of survival and fecundity of individuals and regulation of host population density. Especially in the tropics parasites occur in higher diversity and abundance compared to temperate zones. Not only the geographical latitude is of importance but also ecological factors of the host determine the parasite community richness. Many host specific traits, among others body size, population density and geographic range size, have been proposed to account for patterns in parasite diversity for primates.

In this study we focused on the helminth diversity of three sympatric New World primate species from north eastern Peru. We collected faecal samples from 47 wild individuals from three mixed species groups of *Saguinus mystax*, *Saguinus fuscicollis* and two groups of *Callicebus cupreus* at regular intervals over a 15-month period. Using a comprehensive comparative approach, we are the first to evaluate the influence of hosts' niche specification on parasite diversity in sympatric primates. We explored host-specific factors influencing parasite species richness by collecting data on activity patterns, feeding and ranging, and by measuring several habitat parameters. We found that all individuals were infected by at least one parasite taxon (species or morpho-species). In 430 faecal samples from all individuals, we found propagules of seven different parasite taxa: All three host species differed significantly in parasite species richness, with *S. fuscicollis* showing the highest, *S. mystax* intermediate and *C. cupreus* the lowest parasite diversity. This ranking correlates with differences in diet composition and micro-habitat use, suggesting that differences in parasite diversity result from niche specification of the three primate species. Differences among groups of the same host species also indicated that habitat factors in the respective home ranges may influence the composition of intestinal parasite communities. These results provide a basis for further studies on the interaction between parasites and primates, and on the role of ecological and life-history factors for primate parasite diversity.

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P7.11

Prey foraging strategies of red titi monkeys, *Callicebus cupreus*, in comparison to sympatric tamarins, *Saguinus mystax* and *Saguinus fuscicollis*

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Organisms that are phylogenetically related and live sympatrically on the same trophic level should exhibit differences in their ecological niches, to reduce or to avoid interspecific competition. Previous studies have shown that sympatrically living moustached, *Saguinus mystax*, and saddle-back tamarins, *Saguinus fuscicollis*, show a high overlap in the plant portion of their diet but differ substantially in their prey foraging strategies and prey spectrum.

Here we examine the prey foraging strategies of another New World primate, the red titi monkey, *Callicebus cupreus*, that lives sympatrically with the two tamarin species. Data on strata and substrate use during foraging and on prey searching and capturing behaviour of two *C. cupreus* groups were collected during a 5-month field study in north-eastern Peruvian Amazonia. Comparative data were collected on one group each of *S. mystax* and *S. fuscicollis*. Additionally, prey residuals and faecal samples were collected to facilitate prey identification.

Our results showed that

(1) Prey represented 11% and 15%, respectively, of the diet of the *C. cupreus* groups, which is similar to the amount of prey consumed by the tamarin species (*S. mystax*: 13%; *S. fuscicollis*: 20%).

(2) The *C. cupreus* differed from the two tamarin species in the importance of different substrates where prey was searched and captured. *C. cupreus* mainly searched and captured prey on green leaves. They also captured prey directly from the air, a behaviour never observed in tamarins. In contrast to *S. fuscicollis*, *C. cupreus* never explored tree holes.

(3) Hymenoptera (ants and wasps) accounted for about 50% of captured prey in *C. cupreus*, followed by Coleoptera and Orthoptera; *C. cupreus* never consumed vertebrates. In contrast, katydids are the major prey for both tamarin species (55-65%), who hardly ever consume Hymenoptera or Orthoptera, but include frogs and lizards in their prey spectrum.

These results indicate that different prey foraging strategies might contribute to niche separation between these three primate species and might facilitate their sympatric coexistence. Whether these differences evolved in sympatry or in allopatry remains an open question for future studies.

P7.14

Amphibians as a bio-indicator system for a sustainable biodiversity management in West Africa. Outlook to final phase.

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In order to implement our results from the previous years (shown on a different poster) into applied conservation measures, we will participate with other sub-projects on four principle research axes. First amphibians will be analysed on a macroecological scale. This will allow us to identify so far neglected and unprotected sites of high conservation value, we will model amphibians' distribution patterns and in cooperation with other BIOTA subprojects will model scenarios of likely future biodiversity change, e.g. due to global warming. These models will be translated into direct conservation recommendations. Secondly the effects of different agricultural techniques and land use forms will be investigated. A focus will be on the chemicals (pesticides & insecticides) used in cotton plantations and their effects on e.g. amphibians. Third a supplementation of our results on the effects of logging and fragmentation will compare different forest techniques and evaluate their sustainability. Fourth the overexploitation of frogs as a sustainable protein resource and the likely effects on humans will be studied. We hypothesise that tadpoles strongly regulate water quality and therefore are important for cattle and humans alike.

P10.10

Late Quaternary vegetation, climate and fire dynamics in southern Ecuador – First results from the ECSF research area and El Tiro mountain

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Pollen, spore, charcoal and sediment analysis of different AMS radiocarbon dated lake, bog and soil cores, collected in and around Podocarpus National Park (PN) at elevations between 1900 – 3300 m, as well recent pollen rain will be used to reconstruct vegetation, climate and fire history during the late Quaternary.

First results from the 127 cm long sediment core from the El Tiro mountain at an elevation of 2811 m, located between the Scientific Station Sao Francisco (ECSF) and the city of Loja show that grass paramo was the main vegetation type in the PN region. The tree line shifted to lower elevations and fire was rare during the late Pleistocene period. The grass paramo was rich in Poaceae and *Plantago*, and some other herbs which were less frequent such as *Valeriana*, Cyperaceae and Asteraceae.

Subparamo developed at the study site during the late-glacial / early Holocene. Shrubs of the Melastomataceae family were abundant and increased during the Holocene. *Weinmannia*, *Hedyosmum*, *Podocarpus*, *Ilex* and *Myrsine* were also relatively important genera in the subparamo. The charcoal analysis indicates that fires were relatively frequent during the Holocene. Stronger vegetational changes occurred during the early/mid Holocene, suggesting a change from drier to wetter climatic conditions.

First results from 3 short soil cores at different elevation (1990 m, 2520 m, and 3155 m) of ECSF research area indicate that fires were frequent during the late Holocene but became rare during the last ca. 800 years or even later. Past fires changed the floral composition of the mountain rain forest. The lower ECSF research area has been markedly disturbed during the late Holocene, but probably not during the last centuries. Additional radiocarbon dates will provide a more detailed chronology on environmental changes in the study region.

P11.1

Necessity for silvicultural management: Are *Isoberlinia* dominated woodlands in central Benin (West Africa) able to regenerate after the impact of selective logging?

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Selective logging is the most frequent form of timber wood exploitation in the woodland-savanna mosaic in central Benin. The intensity of the selective logging activities have increased considerably in recent years. Knowledge on the impact of selective logging on the woodland-savanna mosaic is sparse though especially the effects on the recruitment of woody species are of interest for silvicultural management, which is completely absent until now. Therefore gaps created by selective logging in an *Isoberlinia* woodland were compared to undisturbed vegetation types characterised by differing closure of tree cover with respect to the composition and density of seedlings and saplings of woody species during four years. The analyses revealed that certain years were in general favourable and others were unfavourable for the recruitment of woody species. Species composition of both seedlings and saplings of gap plots was similar to *Isoberlinia* woodland, but also similar to the more open vegetation types wooded savanna and tree savanna. Thus, gap plots may have the potential to develop towards more open savanna types. However, if the impact of fire and grazers will not increase excessively and disturbance will be restricted to single gaps, the succession towards *Isoberlinia* woodland seems to be the most probable pathway as seed input is still available and soil parameters are hardly influenced by gap creation.

P1.2

Population genetics of the water hyacinth *Eichhornia crassipes* and *Eichhornia azurea* (Pontederiaceae)

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Eichhornia crassipes (Mart.) Solms (common water hyacinth) and *Eichhornia azurea* (Sw.) Kunth (anchored water hyacinth) are the most common water hyacinth species in South American freshwaters. Because of their extremely fast reproduction and high biomass production, and their aggressive spread all over the world these species are of high biological and economical interest. The Invasive Species Specialist Group (ISSG) has nominated this species as among the 100 "World's Worst" invaders.

E. azurea dominates in the southern part of South America, *E. crassipes* in the northern part. In some parts of South America they occur both. *E. crassipes* reproduces mainly by clones, *E. azurea* by seeds. *E. crassipes* can float freely, unlike its congener *E. azurea* which must root to the substrate and is therefore confined to shallow ponds and the edges of lakes and rivers.

The present project aims at analysing patterns of gene flow and genetic structure of the two *Eichhornia* species, in native South American populations and in introduced populations worldwide. The main questions are:

How genetically diverse are individuals, clones, and populations in the native range of distribution, and in introduced populations?

Can their colonization path be traced back by genetic fingerprinting? Are there bottleneck effects? To which degree are the populations inbred, are there inbreeding depressions and heterosis effects?

The above aspects require a local as well as a regional approach. Appropriate genetic markers and methods have been developed and are in progress (AFLPs, ISSR, cpRFLPs). To date, 169 Individuals were sampled within 7 populations (6 from South America, 1 from India) with 119 Individuals investigated using AFLP markers.

Two discrete groups that do not reflect the two species can be separated, with several partial populations of *E. crassipes*.

The Indian population can be separated at the base of the first group.

Perhaps hybridization of the two species occurs (experiments like chromosome counts are needed to test this). The Northernmost population is geographically close to two other populations (geographical barriers influencing gene flow?).

It is possible that *E. crassipes* migrated from a hypothetical „hybrid zone“ to the South 2 or even 3 times.

The Southernmost *E. azurea* split into two partial populations, one could be separated but the second one is still linked to the population of the „hybrid zone“. Did also *E. azurea* spread from the „hybrid zone“ to the south, possibly twice.

P7.12

Forest structure and tree species composition of the Sumaco-Galeras National Park, Ecuador

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Forest structure and tree species composition were investigated in the Sumaco-Galeras National Park in Ecuador. The investigation area is located on the eastern Andean slope and consists mostly of primary tropical montane forest. The investigation was performed on permanent plots of 20 by 20 meters. The mapping of forest structure followed the catalogue of structural characteristics proposed by Paulsch (2002), including tree height, stem characteristics, branching pattern, leaf shape, leaf size, epiphytic coverage etc.

This was amended by a second approach within the same plots: We measured the diameter of all trees with dbh \geq 10 cm and counted the number of stems with dbh \geq 5 cm. Additionally, voucher specimens for the later identification were prepared from all tree species. All tree individuals with a dbh wider than 10 cm were individually marked.

26 plots were installed (11 for the second approach) at the southern slope of the volcano Sumaco in an altitude between 1580-2040 masl, and 19 plots (7 plots for the second approach) at the Cordillera Galeras between 1050-1590 masl.

A first data analysis revealed different forest types based on forest structure between the two locations and along the altitudinal gradient within each location.

Species composition and richness is changing with elevation at both sites with Amazonian lowland species occurring mainly in the Cordillera Galeras, whereas forests at the Sumaco volcano show more Andean montane forest species. Observed species numbers with dbh \geq 5 cm ranged between 30 and 50 in most plots.

The observed differences in structure and tree species composition may be caused by differing soil conditions, as the Sumaco volcano is dominated by young volcanic soils, whereas the Cordillera Galeras is characterised by sediments. Corresponding investigation of soil properties will be performed in the near future.

We thank the CORBS and the administration of the national park for their logistic support and the BMBF for financial support.

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P7.3

Observations about the permanence of *Typha domingensis* stands in former mangrove areas

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As a result of alterations in the hydrological conditions during the last fifty years, 287.5 km² of mangrove forests have died in the lagoon system of the Ciénaga Grande de Santa Marta (Caribbean Coast of Colombia). The rebuilding of several connecting channels between the Magdalena River and the lagoon system (1995-1998) renewed the fresh water flow from the river to the lagoons. The reduction of the salinity achieved in this way was thought to be a first step towards the regeneration of the mangrove forests. However, the establishment of new mangroves was slow to start. Instead, aquatic plants spread throughout the channels and lagoons in the western part of the lagoon system. Among these plants was *Typha domingensis* Pers., a native to Colombia, also known as an invasive species. Within three years, *T. domingensis* occupied most of the area formerly inhabited by mangroves, up to a distance of 27 km east from the bank of the Magdalena River. The plants established themselves in sites that were flooded at least during the rainy season, and where, during the same season, the salinity of the surface water did not exceed 3 – 5 ‰. During the dry season, the green aboveground parts of the plants frequently dried up, but sprouted again after the rise of the water level. Studies conducted in 1999 showed that low surface water salinity was the most important factor in allowing the establishment of the cattails. When flood levels were high, soil water salinity at a depth of 40 cm did not influence the growth of the plants. From 2001 on, growth conditions for *T. domingensis* changed for the worse as the annual rainfalls have been below the average of previous years, and because sedimentation in the channels reduced the fresh water flow. The *T. domingensis* stands growing in areas with high soil salinity were first injured. At these sites, fires broke out during the dry season of 2001, destroying both cattails and mangrove saplings. These cattail stands did not recover. In areas with moderate soil salinity, the cattails were negatively affected due to reduced flooding but did not completely disappear. Though *T. domingensis* is said to show some resistance to salinity, the decline of its stands demonstrates that the species is not well adapted to saline mangrove soils. Nevertheless, during very rainy years, spreading may begin again if mangrove recovery does not proceed quickly.

P13.2

African army ants and ant-following birds: effects of habitat fragmentation

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Flocks of birds following the swarm-raids of army ants are frequently seen in rainforests of the old and new world tropics. The birds prey on insects fleeing from the marauding army ant swarms. The interaction between army ants and ant-following birds might be altered when forests get fragmented. First, we studied attendance of ant-following birds at 100 swarms of two epigaeic army ant species living in different-sized fragments of a mid-altitude rainforest in western Kenya. A preliminary analysis revealed alterations of flock composition in relationship to habitat fragmentation parameters. Second, in order to describe species-specific responses of ant-following birds and army ants to habitat fragmentation we monitored their abundance (by point-count monitoring) in 11 study sites in forest fragments ranging from 65 to 8,245 ha over two four-month periods in 2004 and 2005. We analyzed whether ant-following bird abundance is related to habitat fragmentation parameters and army ant abundance.

P12.1

Species richness of ants and the impact of invasive "tramp" ant species in plantations of oil palm *Elaeis guineensis* in Borneo and the Peninsula Malaysia

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Malaysia is a famous hot spot of biodiversity, e.g. more than 630 species of ants are reported from Kinabalu National Park in Borneo (<http://www.antbase.de>). However, in the last 30 years the conversion of primary forest into agricultural land has expanded rapidly in Malaysia. In 2000 more than 3 Mio ha were covered by plantations of the oil palm *Elaeis guineensis*, a native wetland species from West Africa. Establishment of oil palm plantations includes a total clearing of the forested land of vegetation and terracing of the ground, both leading to a complete change of the ecosystem. Up to now we had only little information about insects that live in these huge agricultural areas.

Within these plantations integrated pest management can massively reduce the application of insecticides, while insertion of organic matter may help to rebuild the soil structure. Our ongoing project aims at monitoring the effects of these treatments and wants to improve the ecological control of pest insects. As a basis for further research we investigated the impact of oil palm cultivation on the natural ant fauna in Malaysia. Here we compare the diversity of the ant communities in canopies of oil palm plantations in Sabah and Peninsula Malaysia and investigate the influence of non-native ant species.

The arboreal ant fauna was monitored by cutting and examining palms' fronds in two large oil palm plantations in Sabah (Tawau) and the Peninsula Malaysia (Banting) that are farmed with integrated pest management for at least 10 years. In 2004 we sampled the ant fauna of altogether 661 palms in Tawau, in 2005 we conducted research on 532 palms from Banting. Species richness of ants was similar in both plots with 34 ant species in Banting and 35 species in Tawau. The ant community consisted of dominant and subdominant ant species that formed an arboreal ant mosaic: incidences of some species were positively correlated with each other, while other species excluded each other from single palms. *Technomyrmex albipes*, *Oecophylla smaragdina* and *Anoplolepis gracilipes* dominated the arboreal communities. We found a high influence of non native species: altogether 47 % of all species occurrences belonged to 9 invasive "tramp" ant species. The high abundance of these pan-tropical ant species may endanger Borneo's natural ant diversity.

P12.10

Spatial patterns in a tropical creek anuran assemblage and principles of species richness in tropical rain forest ecosystems

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Tropical rain forests are distinguished by their extraordinary biodiversity and often high degree of endemism. The wet tropics exhibit higher species richness than a comparable area in the temperate zone. The ecological and evolutionary principles, which facilitate the coexistence of large numbers of species, remain unknown. Presently, two theoretical models are discussed: (1) the non(competitive)equilibrium, stochastic fluctuation model, based on a high β -diversity and a high niche overlap of many species, and (2) the deterministic equilibrium model, which, based on interspecific distribution of existing resources, results in a low β -diversity (HUSTON, M. A. (1994): Biological Diversity. The Coexistence of Species on Changing Landscapes.-Cambridge Univ. Press). Validation of these models is still in progress. This process will likely contribute to the understanding and conservation of tropical rain forest ecosystems and other areas of high biodiversity.

We conducted visual encounter surveys and ecological studies in an anuran creek assemblage in a secondary tropical rain forest at Mt. Nlonako, Cameroon. The study focused on surveying and monitoring of anurans, and on habitat selection and spatial niche partitioning. During 54 night transects, between December 2002 and May 2003, we observed 1308 specimens representing 43 species. For each specimen, we employed criteria for potential micro-habitat characteristics and recorded the individual perching site (vertical and horizontal). We grouped all species in three categories, based on vertical patterns (ground-dwelling, lower vegetation, higher vegetation). Cluster analyses for each of these categories and all three combined indicate interspecific correlations between systematic and ecological arrangements.

Within some genera, e.g. *Astylosternus* or *Leptopelis*, species show a strong overlap in habitats. In some cases the correspondence of systematic groups with spatial niche width can be observed within families, e.g. *Astylosternidae* (*Astylosternus*, *Scotobleps*) or *Arthroleptidae* (*Arthroleptis*, *Cardioglossa*). Contrary to that, some species exhibit niche overlap with distant systematic units (genera or families) and can be considered "niche-invasive", e.g. *Chiromantis rufescens* and the genus *Leptopelis*.

Vertical distribution patterns are considered decisive competitive exclusion parameters within spatial niche dimensions, but it was not a dominating variable in the agglomerative cluster-analyses. For example, the species cluster *Petropedetes cameronensis* – *P. newtoni* shows strong general ecological correlation, although both species were observed at different perching heights.

Our results support the stochastic fluctuation model and allow first insight in the principles of multi-species anuran coexistence by similar habitat selection and high niche overlap of closely-related species.

P7.7

High specificity characterizes the relationship of Orchids, Liverworts and their symbiotic Fungi

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One focus of the DFG research group "Functionality in a Tropical Mountain Rainforest: Diversity, Dynamic Processes and Utilization Potentials under Ecosystem Perspectives" is to investigate whether different plant groups with identical fungal guilds share the same fungi at the specific level. Our group is interested in the Pleurothallidinae epiphytic orchids and the terrestrial liverwort species *Aneura pinguis*. Both plant groups are common in the mountain rainforest and although separated by different substrates they occur in the same forest types and often adjacent to each other. The basal Basidiomycetes of the Tulasnellales are mycorrhizal partners of both groups. By sequencing the large subunit of the fungal ribosomal gene, we came to the following conclusions:

(1) In spite of their obvious rareness as fruiting bodies, Tulasnellales are frequent in mycorrhizas of the Pleurothallidinae orchids and *Aneura pinguis*. (2) The mycorrhization is highly specific: we could not find any identical fungal species in the two plant groups. (3) Mycorrhizal Tulasnellales are a genetically highly diverse group in the mountain rainforest. (4) The observed Tulasnellales are dispersed over all described sections within this taxonomically hardly understood group.

P3.1

Movement patterns of five rodent and two marsupial species in forest fragments of the coastal Atlantic Rainforest, Brazil

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Investigation of movement patterns provide important information on diverse population biological parameters such as spatial habitat use and are essential for a better understanding of the ecology of a species. The mean distances moved between successive captures, frequencies of movements and the mean maximum distances moved were investigated in five rodent and two marsupial species in forest fragments of the coastal Atlantic Rainforest (Mata Atlântica) in the state of São Paulo, Brazil. The investigated species were the rodents *Akodon montensis* (Thomas 1902), *Oligoryzomys nigripes* (Olfers 1818), *Delomys sublineatus* (Thomas 1903), *Oryzomys russatus* (Wagner 1848), and *Thaptomys nigrita* (Lichtenstein 1829), and the marsupials *Marmosops incanus* (Lund 1840) and *Gracilinanus microtarsus* (Wagner 1842). *A. montensis* differed significantly from all other investigated species and moved the lowest mean distance and the lowest mean maximum distance. The marsupials differed significantly from most of the rodents and moved the largest mean distances between captures. Except of *M. incanus*, which moved most in the distance class of 20-30 m, all species showed the highest frequency of movements in a distance class of 0-20 m. Differences between sexes in mean distance moved was detected for *O. nigripes*, *O. russatus* and *G. microtarsus*. In these species males moved significantly larger distances than females. The different study sites had no influence on the mean distance moved in any of the investigated species. Only the males of *G. microtarsus* showed a seasonal variation in mean distance moved longer mean distances in during reproductive activity. Biological implications of the results are discussed.

This study is part of the BIOCASP project (Biodiversity conservation in fragmented landscapes on the Atlantic Plateau of São Paulo, Brazil). We appreciate the financial support provided by the BMBF Germany.

P12.14

Simulating Simultaneously the Impact of Important Factors on the Forest Model System FORMIND, adapted to the Atlantic Rain Forest in São Paulo (Brazil)

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The Brazilian Atlantic Rainforest (MATA ATLANTICA) is one of the biodiversity hot spots in the world, but this biome is highly endangered through habitat destruction. Approximately 95% of the former Atlantic rain forest has disappeared within the last 5 centuries and the remaining forests are highly fragmented. Now there is urgent need to investigate, whether these remaining rain forest fragments are potentially able to regenerate to (near) natural rain forests and under which conditions this might be possible. As the dynamics and the regenerative ability of tropical rainforest fragments are not well understood, it is necessary to investigate how a tropical rain forest behaves under different assumptions concerning the key biological processes as e.g. dispersal, recruitment or mortality.

As tree species in general are long-lived individuals it is extremely difficult to investigate forest regeneration dynamics empirically. Thus, we use a forest simulation model (FORMIND) within the Brazilian-German research program BioCAPSP, which was developed for tropical rain forests and which was already applied successfully to different tropical rain forests. FORMIND simulates the essential biological processes concerning the dynamics of trees, following the gap model approach and grouping tree species into Plant Functional Types (PFTs). The individual oriented simulation models simulates key processes as dispersal, recruitment, light competition, mortality and others at the level of individual fully-grown trees, i.e. one grid-cell extends to 20m x 20m and the whole area simulated comprises several hectares. FORMIND was now parameterised for a site near São Paulo, Brazil, and we now tested how strong model behaviour would change, if the estimated input values are changed for different processes, e.g. recruitment or mortality. Parameters were changed simultaneously within an assumed biologically reasonable range to test the sensitivity of the model behaviour to these changes. Thus we are able to estimate how large the uncertainty concerning the input factors affects the resulting model behaviour.

We will present exemplar simulation results out of the described experiments, e.g. how different key processes as dispersal, regeneration, mortality or other important factors affect the behaviour of the model system. Further we will present how different regeneration scenarios like external seedling input vs. local regeneration affect the model system behaviour, and if it modifies the relative effect of other key processes as e.g. mortality.

We will discuss these results with respect to the consequences for potential regeneration and recovery of fragmented tropical rainforests.

P12.13

Seed dispersal of Solanaceae by the bat *Sturnira lilium* (Chiroptera: Phyllostomidae) in the montane Atlantic Forest of southeastern Brazil

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Seed dispersal may have different consequences on plant species, both at the population and at the community level. Phyllostomid bats are good models for testing some hypotheses regarding mutual benefits of this interaction. Within phyllostomids, *Sturnira lilium* plays a particularly important role in this process, because it is widespread, very abundant and feeds on a large variety of fruits, mainly of the family Solanaceae. The present study focused on some aspects of the interaction between Solanaceae and *S. lilium* in the Brazilian montane Atlantic Forest, in order to test the quality of seed dispersal delivered by bats, in the context of the 'escape' and the 'colonization' hypotheses. We monitored bat diet and foraging behavior by mist-net captures and radiotelemetry, and simultaneously assessed spatial distribution and phenology of plants. Results suggest a steady-state strategy in fruit production by the Solanaceae, a strong preference of *S. lilium* for those fruits, low roost fidelity both during night and day, and large commuting distances and foraging areas in comparison to other small mammals. We observed also a seasonal variation in bat activity mainly related to air temperature but also to fruit crop, and a probable seasonal migration. We conclude that seed dispersal by *S. lilium* is highly beneficial to plants consumed, because those bats feed on them regularly, carry seeds away from mother-plants, transport seeds over a large area and drop them in multiple sites. Furthermore, feeding behavior of *S. lilium* is likely to affect distribution of plants in local communities and therefore species diversity.

P2.6

Feeding habits of the bat *Sturnira lilium* (Chiroptera: Phyllostomidae) in the montane Atlantic Forest of southeastern Brazil

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Bats are the second largest order of mammals, and due to their high abundance and diverse diets they are crucial to the diversity and dynamics of tropical forests. Members of the family Phyllostomidae present all feeding habits observed among bats, and stenodermatines like *Sturnira lilium* are specialized frugivores that play important roles in the process of seed dispersal. The goal of the present study was to describe the diet of *S. lilium* in the montane Atlantic Forest of Brazil, and to address the potential role of climate (temperature and precipitation) and food availability in determining its seasonal population fluctuations. We captured bats in mist-nets in 15 monthly sessions (n = 36 nights) to collect fecal samples. Simultaneously, we monitored climate and phenology of the main known food-plants of *S. lilium* to assess variations in resource availability. The diet of *S. lilium* consisted exclusively of fruits with a preference for Solanaceae, although the bats fed also on Piperaceae and Cecropiaceae with seasonal changes in proportions. Our results confirm general feeding habits of *S. lilium* observed in other localities, and support the tight relationship between those bats and Solanaceae, and the importance of *S. lilium* as a seed disperser. Interestingly, the consumption of fruits of Solanaceae was not related to their phenology, unlike in other small phyllostomids where an increase in fruit crops leads to an increase in consumption of particular fruits. Bat abundance peaked twice as opposed to one peak of fruit production. Furthermore, bats were almost absent in the area during colder and drier months, although fruits were available (especially at the end of this period), when they probably migrated to lower and warmer altitudes. We suggest that *S. lilium* migrates in order to escape low temperature and reduced availability of Solanaceae fruits in environments at higher altitudes during the cold and dry season.

P2.4

EDIT: The European Distributed Institute of Taxonomy: A network for integration of taxonomy supported by the European Commission

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Taxonomy provides the basis for understanding biodiversity. Overcoming the taxonomic impediment involves both having enough trained taxonomists and having taxonomic information available to those who need to use them. The European Distributed Institute of Taxonomy project, EDIT, is a European Commission sponsored Network of Excellence aimed at starting to overcome the taxonomic impediment through collaboration and joint work programme. Through EDIT we hope to build capacity globally and provide information and tools for use by all. The EDIT proposal is an initiative of the Consortium of European Taxonomic Facilities (CETAF) which since 1996 has been working for better integration of the taxonomic effort in Europe.

The project should help to reduce the fragmentation in European taxonomic research and expertise and to co-ordinate the European contribution to the global taxonomic effort, in particular the Global Taxonomy Initiative, through an integrated initiative aimed at improving society's capacity for biodiversity conservation. EDIT, which is lead by the Muséum National d'Histoire Naturelle in Paris, focuses on improvement of both production and delivery of taxonomy through (1) coordination of the research policies of its member institutions, which employ altogether ca 1500 researchers and doctoral students in taxonomy; (2) progression toward integration of their scientific expertise and infrastructures to improve both production and access to taxonomic knowledge and information, within the network as well as in the framework of international structures and initiatives, such as the GBIF and the GTI; and (3) induce cultural change allowing improvement in the production of taxonomic results by building an internet platform for elaboration and publication of collaborative revisions on the web, and making this platform freely available to all taxonomists worldwide.

The EDIT project consists of eight workpackages, dealing with coordination and management (ST), integrating the expert and expertise basis (HE), integrating of infrastructure (WL), research coordination (MR), an internet platform for cybertaxonomy (WB), unification of revisionary taxonomy (MS), applications of taxonomy for conservation (CH) and training and public awareness (JvG)

As a whole, these workpackages address infrastructural, scientific and cultural impediments which hamper both development and availability of taxonomic knowledge. They will facilitate availability of taxonomic data, acquisition of new taxonomic knowledge and support taxonomic capacity building far beyond members of the EDIT consortium, in particular in developing countries.

The EDIT contract will start in early 2006. The EDIT network holds the most comprehensive body of literature, specimens, research and expertise in the world. During five years the network will build up a virtual center of excellence widely opened to users and potentially expandable worldwide.

P6.11

Variability of precipitation input in the Reserva Biológica San Francisco, Southern Ecuador

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Precipitation is one of the most important variables affecting biodiversity in all ecosystems. This holds especially true for tropical mountain forests of the andes, where additional water input is provided by scavenging of fog and cloudwater. Unfortunately, knowledge of the precise amount of precipitation in these regions is very scarce and temporal and spatial distribution is almost unknown, due to the low density of climate stations. The Project PREDICT employs modern techniques like remote sensing (Radar, satellite imagery) and meteorological data, to overcome these limitations. An altitudinal gradient of fog collection devices and rain water samplers provide information about vertical variations of rain and fog input. The data are collected with high temporal resolution and on a long-term basis.

Rainfall for this area is much higher than known and a significant amount is contributed to the hydrological cycle by fog-scavenging. Rainfall distribution in the study area is highly dependent on orographic situation and exposition to the prevailing easterly trade winds. Fog input is controlled by wind speed, cloudiness and topographic situations. Rainfall maximums of 5500 mm/year are exceeded in some parts and fog may contribute further 400 to 500 mm annually.

P11.4

Effects of fragment size on vertical niche partitioning of frugivorous bats in the Atlantic Rain Forest of Northeast BrazilSá-Neto, R.J.¹, Leal, I.R.² & Tabarelli, M.²¹Departamento de Ciências Naturais, Universidade Estadual do Sudoeste da Bahia, Vitória da Conquista, Brazil²Departamento de Botânica, Universidade Federal de Pernambuco, Recife, Brazil

Forest fragmentation causes changes in community structure and interrupts key ecological process such as seed dispersal. Frugivorous bats (FB) play an important role as seed dispersers in tropical forested ecosystems. However, earlier studies have demonstrated that Neotropical FB communities are less affected by habitat fragmentation than other frugivores. This finding has been explained by the facts that these bats are not easy to hunt and that they feed on fruits, mainly from pioneers species that are abundant in fragmented forests. According to their vertically stratified foraging habit they are divided in two strata guilds canopy (CFB) and understory (UFB) fruit bats. The goal of this study was to verify whether habitat fragmentation can affect this vertical niche partitioning by FB. For this, we selected three Atlantic Forest fragments of different sizes located at the Usina Serra Grande (35°52'W e 9°00'S), Northeast Brazil. Bats were caught by mist-nets (set up between 1700h and 2400h) from August to December 2002 at three sampling points within each fragment. FB were identified and classified into strata guilds. In addition fecal samples were sampled, analysed and grouped into four food items: arthropods, pollen, fruit pulp and seeds. 'Fruit pulp' derived from large seeds which can not be ingested by bats. The 'seed' category included seeds indigestible by bats, this seeds was identified until genus or family level, and then this food item could be classified into vegetative habits. Overall, we analysed 348 fecal samples of 13 FB species, 188 from a large fragment (3,500ha), 97 from a medium-sized (270ha) and 63 from a small fragment (80ha). CFB and UFB consumed more fruits (fruit pulp + seeds) than other food items. In both the medium-sized and the large fragment CFB consumed more fruit pulp while UFB consumed more seed. In the small fragment, however, there were no dietary differences in the fecal samples of CFB and UFB. In the small and medium-sized fragments both strata guilds consumed more fruits of shrubs and understory trees, while in the large fragment CFB fed more on fruits of canopy trees and UFB consumed more shrub and understory fruits. These results suggest that in small forest fragments CFB are broadening their diet by increase the proportion of fruits of understory plants consumed. Probably, large forest fragments provide a higher availability of fruiting canopy trees and vertical niche partitioning among bats is therefore more distinctive than in small fragments.

P2.1

Effect of nutrient addition on the soil microarthropods of a tropical montane rain forest in southern Ecuador

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In this study the effect of nutrient (N, P) and carbon (C) addition on the soil fauna and on fungi of a tropical montane rain forest was investigated in a field experiment in Southern Ecuador. Nutrients and carbon were added separately and in combination to experimental plots for 12 months. In total the equivalent of the five-fold annual input of litter was added.

Little is known about the effect of resource addition on microarthropods in tropical montane rainforests. We hypothesized that bottom-up effects are structuring forces for the density of decomposer animals affecting lower trophic levels (fungi) and that they will propagate to higher trophic levels but with decreasing intensity due to the dampening of bottom-up forces at higher trophic levels. Furthermore, we hypothesized that indirect effects such as the dominance of a single species (e.g. earthworms or other large decomposers) after fertilisation are of limited importance in a tropical montane forest since (1) large decomposers are rare due to base poor tropical soils and (2) no key stone species exist.

The results supported our hypotheses. The fungal biomass increased after addition of nitrogen and carbon. Density of Astigmata, Entomobryidae, Onychiuridae and juvenile Oribatida and predatory taxa (Uropodina, Gamasina) increased after N or C application. Some taxa remained unaffected (Prostigmata, Formicidae and some taxa of oribatid mites).

One aspect of this study was the question what consequences arise from the input of nitrogen due to biomass burning in the Amazon basin. The long term input of fertilizers is likely to affect montane tropical rain forests in the future and their effects have hardly been studied until now. Our results show that the input of nitrogen may in fact have an impact on the soil animal community indicating that not only clearings of rainforests affect these ecosystems but also the biomass burning in tropical lowlands.

P11.9

The role of seasonality in structural assessments of tropical montane forests

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Leaf-Area-Index (LAI) is the total one-sided area of leaf tissue per ground unit. It is a key parameter in ecophysiology and in contiguity with the Canopy Openness an important value for the description of the canopy structure and temporal and spatial heterogeneity in forest stands. LAI and Canopy Openness can be easily provided by the analysis of hemispherical photographs, which is a widely used method for indirectly assessing canopy characteristics.

We addressed the following questions: i) how can structural differences between forest sites be quantified using LAI / Canopy Openness? ii) how do these parameters change in response to climate seasonality? iii) are fine scale differences in forest structure detectable by LAI / Canopy Openness?

We established a 10x10m grid in two plots where two series of hemispherical photographs were taken with a NIKON Coolpix 4500 digital camera. The first series was taken at the end of the dry season in November 2004 and another one at the end of the wet season in June 2005. The pictures have been analyzed with the WinSCANOPY Software by Regent Instruments.

To provide basic climate data (temperature and relative/absolute humidity) we mounted several Onset-Hobo data-loggers (temp/rH) in the forest stands.

We selected two sample sites in the Brazilian Atlantic Forest in the State of Rio de Janeiro, municipality of Teresopolis. The general climatic conditions of the area are tropical montane humid with wet and hot summers (November to February) and dryer and colder winters (May to August). One 1ha plot was located in a 11.000ha forest reserve ("Parque Nacional Serra dos Órgãos") with mature montane coastal rain forest, already 65 years under protection. For the other 1ha plot we selected a 60ha forest fragment with secondary forest, dominated by semideciduous tree species such as *Piptadenia gonoacantha* (Mimosaceae) in 25km distance to the National Park. This fragment is surrounded by small agricultural patches.

We examined the influence of the seasonal climate on LAI and Canopy Openness in two research sites: in a mature forest stand and in a forest remnant, dominated by secondary growth. We recognised a significant variability of LAI / Canopy Openness between the central parts and the border region of the forest fragment. There was no comparable variability in the national park. The higher influence of seasonality on LAI/Canopy Openness resulting in perspicuously higher within-canopy dynamics in the forest remnant have been put down to a structural response to temperature and absolute humidity, due to the low species diversity and a higher abundance of semideciduous tree species. The high species richness in the mature forest site with a lower abundance of semideciduous pioneer species prevents such impact on the canopy structure and its spatiotemporal dynamics.

We observed an obvious "edge effect" according to the structural changes by the seasonality in Canopy Openness: decreasing difference of canopy-openness with increasing distance from the edge. A possible reason could be the distribution of semideciduous tree species in the fragment with concentration on the forest edge. There was no such effect in LAI, which demonstrates that there is no conclusive dependency between LAI and Canopy Openness.

P12.17

Floristic and structural variability of the understory vegetation along abiotic gradients in the tropical montane rain forest of the Mata Atlântica in the National Park Serra dos Órgãos, RJ, Brazil

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Within the BMBF funded project BLUMEN (Biodiversity and integrated land use management for economic and natural system stability in the Mata Atlântica of Rio de Janeiro) we studied the floristic and structural distribution patterns of the understory vegetation along abiotic gradients in the tropical montane rain forest of the Mata Atlântica in the National Park Serra dos Órgãos, RJ, Brazil.

The principal aims of this investigation were the floristic and structural characterization of the understory vegetation, its classification based on floristic similarity and the analysis of the dependence of the floristic variability on topographic and abiotic factors.

The floristic composition, structure and diversity of the woody understory vegetation (diameter < 5 cm, height \geq 1 m) were investigated within 21 sample plots (each 100 m²) along an altitudinal gradient (1130 to 1620 m a.s.l.). From each sample site certain topographic (e.g. altitude, inclination, slope aspect) and abiotic variables (light conditions, soil characteristics) were documented.

Within these 21 plots we found a total of 263 species comprising 46 families. According to their Family Importance Value Index (FIV) the most important families in the study sites are Myrtaceae, Rubiaceae, Arecaceae, Lauraceae, Melastomataceae, Nyctaginaceae, Mimosaceae, Myrsinaceae, Monimiaceae and Moraceae. Considering their Importance Value Index (IVI) the most important species are *Euterpe edulis* (Arecaceae), *Guapira opposita* (Nyctaginaceae), *Psychotria suterella* (Rubiaceae), *Inga lanceifolia* (Mimosaceae) and *Psychotria pubigera* (Rubiaceae).

Corresponding to their floristic similarity the 21 plots can be arranged in three groups using Cluster analysis, Two Way Indicator Species Analysis and Correspondence Analysis. For each of these groups it was possible to identify various indicator species.

A total of 47 % of the floristic variation between the sample sites can be explained by spatial (23 %) and environmental (24 %) heterogeneity. Altitude, canopy cover, slope aspect and the thickness of the organic soil cover were identified as the most important differentiating factors within the environmental variables. Hence it could be concluded that the floristic variability within the study area is caused mainly by the topographic conditions of the mountainous landscape and the light availability.

P7.8

Local floral neighbourhood and pollen quality affect the reproductive success of the neotropical understory herb *Heliconia metallica*

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Heliconia metallica is a common understory herb of Neotropical rainforests. Large populations with a high proportion of flowering plants are restricted to small gaps within the floodplain forest. Plant density declines with canopy closure which might lead to local population extinction, indicating that the colonization of new sites is crucial for metapopulation dynamics. As the colonization process is supposed to be seed-limited, the reproductive success of a population might strongly influence the metapopulation dynamics of *H. metallica*. From this background, we analysed the effects of local floral neighbourhood and pollen origin on fruit and seed set of the hummingbird-pollinated *H. metallica* in south-eastern Peru.

We collected 253 fruits from 82 flowering plants, measured their distance to the next three flowering plants and determined the number of seeds per fruit. Moreover, we carried out 142 artificial hand-pollinations in 47 plants that were bagged with nylon mesh to prevent pollination by hummingbirds and fruit removal. We compared fruit and seed set among the following pollination treatments: (1) no artificial pollination, (2) artificial self-pollination, (3) hand-pollination with pollen from one father plant, and (4) hand-pollination with pollen from six different father plants.

A small mean nearest neighbour distance positively affected the number of seeds per fruit, indicating a positive effect of cross-pollinations among neighbouring plants on reproductive success. In line with this, the pollen origin strongly affected the reproductive success. Flowers without hand-pollination did not develop fruits, indicating that the species is not self-pollinating. Flowers that received self-pollen developed less fruits, less seeds and lighter seeds than flowers that received cross-pollen, indicating a partial self-incompatibility. Moreover, seed set per fruit was higher in flowers that were pollinated by pollen from six fathers than in flowers that received pollen from one father plant.

Cross-pollination increases the fruit and seed set in *H. metallica*, suggesting that changes in the local floral neighbourhood might affect the metapopulation dynamics of the study species. We conclude that understory plants that depend on increased light availability for reproduction might benefit from edge effects in fragmented forests. Higher light availability along edges does not only increase the density of flowering plants, but also the reproductive success of each individual, suggesting that forest fragmentation might change the vegetational composition of the rainforest understory in favour of these species.

P2.8

Ants at bromeliad inflorescences – hunting mites or collecting nectar?

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The visitors of bromeliad flowers span a wide range of taxa reaching from birds to several orders of insects. Besides the typical flower visitors like bees, flies and butterflies, ants are often seen on inflorescences of the bromeliad *Aechmea lindenii*, growing in secondary forests at Florianópolis, Santa Catarina Island, Southern Brazil. In addition to describing the frequency of the association with flowers and the diversity of ants involved the purpose of this study was to examine the interactions between ants and the inflorescences of the bromeliad *Aechmea lindenii* and to answer the following questions: What attracts ants to the inflorescences and what do they do there? More specifically, do they seek floral or extrafloral nectar or do they hunt for prey? To answer these questions inflorescences were examined for the presence of extrafloral nectaries and it was determined how often ants co-occurred with flower mites and where on the flowers ants mostly stayed.

Ants were observed on 88 % of young inflorescences with still closed flower buds, on 92 % of inflorescences with open flowers and on 88 % of inflorescences with all flowers closed (but unripe fruits). Ants of 18 genera were found with *Crematogaster*, *Solenopsis*, *Camponotus* and *Brachymyrmex* being the most frequently recorded. The presence of extrafloral nectar was confirmed after excluding all flower visitors by bagging of inflorescences. It is secreted at the sepal tips of flower buds, open and withered flowers and contains 18 to 36 % sugar. Co-occurrence of ants and mites was high in open inflorescences. Most ants frequently inspected the sepal tips and spent a lot of time at these locations.

There is a high species richness of ants recorded on the inflorescences of *Aechmea lindenii*. Visiting frequency and preferred location of ants at the inflorescences indicate that the main interest of ants seems to be the exploitation of extrafloral nectar. While the benefits of this association for the ants are obvious, the advantage of the bromeliads to attract ants is still an open question. The permanent presence of ants on the inflorescences might enhance the reproductive success of the bromeliads, for example by preying on pollen-eating mites or other herbivores that feed on flower or fruit tissue. This hypothesis should be tested by exclusion experiments.

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P4.2

Modelled distribution of photosynthetic pathways for Poaceae in the Sahel of Burkina Faso

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For our study area in the Sahel of Burkina Faso, species distribution models were calculated using GARP (Genetic Algorithm for Rule-Set Production) and based upon 1461 phytosociological relevés and 800 specimens from the West Africa Collection of the Herbarium Senckenbergianum (FR). Only grass species which had at least 15 spatially unique distribution records were included in the analysis. For each species 20 models were generated and the best ones selected based on omission and commission values.

Species were assigned to photosynthetic pathways (C3, C4 with subtypes) according to literature and own observations of their bundle sheath anatomy. Modelled distributions of single species were summed up for each photosynthetic type. The few C3 grasses showed a distribution close to water courses, C4 NADP-me preferred dunes and tiger bush, C4 PCK was evenly distributed and C4-NAD-me was found mainly on the pediplain. The preference of certain landscape units corresponds with known water requirements of these groups.

P7.15

Changes in plant species composition following a climatic gradient in West Africa

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In the course of the BIOTA Africa research programme of the German Federal Ministry of Education and Research (BMBF), a continental network of so-called biodiversity observatories has been installed on the African continent. They serve as permanent monitoring plots of biodiversity changes in the context of global change.

Our study areas are located in biodiversity observatories of the West African BIOTA transect in Ivory Coast, Benin and Burkina Faso. Their surface areas of 1 km² each comprise different types of savanna and forest. In a nested design of different monitoring plot sizes, vegetation composition and cover were assessed on plots of 10 x 10 m² (herbs) and 20 x 50 m² (woody species), and complete species inventories were taken on entire hectare and square kilometre surfaces of the observatories.

The results are discussed considering possible effects of climatic factors and human impact with respect to diversity of species and higher taxa, life forms, chorological and photosynthetic types. The savannas in the southern part of the transect (Comoé National Park, Ivory Coast; Pehunko, Benin) show highest numbers of species. They represent predominantly Sudanian floral elements. Lowest species richness is found in the Sahelian Zone in northern Burkina Faso.

The results can contribute to a modelling approach of functional relationships allowing for an extrapolation of the local findings onto a subcontinental level.

P10.13

Impact of traditional coffee management on the biodiversity of natural coffee forests in Bonga region (SW Ethiopia)

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Coffea arabica L. has its origin in the montane rainforests of southwest and south Ethiopia where it is a natural component of the undergrowth. These rainforests, however, are highly fragmented and decreasing at a rapid rate through conversion into settlements and agricultural land. The remaining forests with wild coffee are used for traditional coffee production. This study assesses how much wild coffee can actually be harvested from the forest and evaluates the influence of wild coffee management on the floristic diversity and structure of the forest.

Vegetation surveys were conducted in four forest fragments in the vicinity of Bonga (SW Ethiopia). In 85 study plots (20 x 20 m²), all vascular plant species were identified and height and diameter at breast height (dbh) measured if height > 0.5 m or dbh > 2 cm. The ripe fruits per coffee tree were counted, and the coverage of the forest vegetation as well as other environmental parameters was recorded. The data were analyzed statistically with multivariate methods.

Traditional coffee management involves the removal of shading canopy trees and of shrubs and small trees that compete with coffee in the undergrowth. This leads to an increase in wild coffee yields, but also to a severe disturbance of the forest structure if management intensities are high. As a consequence, there is a rise in the species number and abundance of ruderal herbs, shrubs and pioneer tree species, while typical forest species that require an undisturbed and shaded forest environment disappear. Regeneration of woody species is stimulated by management activities, but most individuals never fully develop due to annual coppicing. This is particularly harmful to large tree species that need a long time to reach a reproductive age.

In order to conserve the original forest vegetation, it is crucial to retain forest parts without intensive coffee management. The population pressure on the forests in SW Ethiopia continues to grow, however, and the economic incentive for intensive management of wild coffee is high. Sustainable management concepts are therefore urgently needed to harmonize economic interests and forest conservation efforts.

P12.8

Architecture of climbing Marantaceae in the tropical rainforest of Gabon

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The Marantaceae (31/530) are a tropical family of predominantly perennial rhizomatous herbs. Climbing species only occur in the African genera *Haumania* (2), *Hypselodelphys* (4) and *Trachyphrynium* (1). The latter two form sister groups in the *Sarcophrynium*-Clade (Prince and Kress 2005) while *Haumania* takes an isolated position on the phylogenetic tree. Architectural analyses of five species (*Haumania danckelmanniana*, *Hypselodelphys hirsuta*, *Hypselodelphys poggenana*, *Hypselodelphys scandens*, *Trachyphrynium braunianum*) were undertaken at the station of biological research in Ipassa Makokou, Central Gabon, during the rain season from September to December 2005. To elucidate the architectural model shoot systems of different ages were studied morphologically. To document the development of the shoot systems, the length of the internodes and the angles between them were measured. One shoot system per species was collected for an exemplified 3D-reconstruction to illustrate the growth habit in space. Basically, all species show the same above-ground architecture which obviously has evolved two times in parallel. The monochasially branched main shoot represents the module encompassing three zones, a first orthotropically sprouting zone in which the shoot system gains height (usually up to 10 meters), a second assimilating zone in which the shoot system hangs arch-like over and bears foliated short-shoots and a third 'zig-zag-zone' in which the shoot system gets firmly attached to possible support plants. Here, foliated short shoots and the inflorescences appear. Climbing is mainly achieved by the angles between the internodes providing the ability of clinging to the branches of other individuals. Growth is continued by reiterative shoots which predominantly appear at the distal nodes of the second zone. They either repeat the whole module or only the distal zones, thus showing a shortening of their development. Dependent on the thickness of the rhizome, the main axes are of different diameter reaching a maximal diameter of 3 cm. Young plants produce foliage leaves in the first zone already to compensate for the still insufficient nourishment through the rhizome. Subscribing the modules to an existing architectural model, the examined species conform quite well to McClure's Model (Hallé et al. 1978) although some details have to be added. To achieve a more exact view of the architecture and construction of the five lianescent African Marantaceae further research concerning anatomy and ontogeny of the shoot systems is currently in progress.

P6.3

Influence of habitat structure and land use type on the predatory macroarthropod community in natural forest and cacao plantation of Central Sulawesi

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Spiders are top predators in the soil food web and they are among the most abundant macroarthropod predator groups in tropical rain forests beside beetles and ants. Data from the literature show that the abundance of ants and spiders in tropical plantations is reduced while the ratio between the two groups remains the same compared to natural forests. This study evaluates the influence of land use change from natural rain forest to cacao plantations on the spider and ant communities in Central Sulawesi.

Litter samples were taken from natural forest and three types of cacao plantations: under natural forest and under shade tree polyculture and monoculture. A litter exchange experiment was designed to examine how changes of habitat structure and land use intensity would affect spider communities. Before the start of the experiment litter was collected from natural forests and cacao plantations and defaunated by careful drying. The material was spread as one species litter and as a mixture on three 1m² plots in each of the four replicates of natural forests and cacao plantations under natural forest trees. We took samples after three and six weeks from each litter plot and matching samples from untreated surrounding litter at each sampling date. Animals were extracted using Winkler-traps, and ants and spiders were identified to family/morphospecies level.

For both taxa the community composition changed along the land use gradient. Formicinae were dominant in natural forests while Ponerinae and Lycosidae dominated in cacao plantations.

While the number of subfamilies of ants / morphospecies of Myrmecinae decreased with increasing land use intensity the densities were generally higher in plantations than in natural forest indicating the stimulation of ant activity by higher litter temperatures but the loss of species due to decreasing habitat heterogeneity and tree diversity. Similar results were observed with spiders where the loss of the F-litter layer and the simplification of the L-litter reduced the possibilities for web building spiders and increased the densities and dominance of cursorial spiders such as Lycosidae. The general trend that defaunated litter had higher densities of ants and spiders than control litter indicates that competition for resources is limiting their densities in the litter layer of tropical forests.

P12.3

Tropical lichens as microclimatic indicator?

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Tropical lichens show specific distribution patterns in closed tropical lowland forests. In the understorey, crustose lichens are predominant at the base and at the lower trunk in companion with bryophytes. Foliose (leaf-like) and fruticose (shrub-like) lichen growth forms occur extremely seldom at this area and are more abundant in the canopy area. How the composition and abundance of growth forms in the understorey vary in correlation with microclimatic conditions, such as light, temperature and humidity, was studied in forest fragments of a North Eastern Atlantic rain forest near Recife, Brazil. Besides of microclimate and growth form, physiological parameter such as response to light and desiccation processes were studied by chlorophyll *a* fluorescence measurements. The latter could indicate the strategy of physiological adaptation at different microhabitats. In a long term, it is evaluated if lichens can be used to estimate microclimatic conditions and degrees of disturbance.

P7.16

Adaptation towards MHC supertypes: evidence for parasite driven selection in a free living primate

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The genes of the major histocompatibility complex (MHC) play a major part in the activation of the immune system. MHC genes display a high degree of variability which is thought to be maintained by parasite driven selection. In a natural population of the fat-tailed dwarf lemur (*Cheirogaleus medius*) we identified 50 alleles of the duplicated MHC DRB (exon 2) locus. For the first time we used an in silico method to identify eleven DRB supertypes based on shared binding similarities in free living lemurs. We investigated the importance of MHC-supertype variation on the intestinal nematode burden. The number of individual supertypes had no influence on the nematode burden. However, we found a specific supertype (supertype 1) that was linked to infection, a higher number of different nematode infections and high fecal egg counts per individual. Moreover, we found one rare supertype (supertype 7) that was advantageous with respect to all measures of parasite burden. Our results support the hypothesis that MHC variability is maintained by parasite mediated frequency-dependent selection.

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P9.3

The concept of a Pollinator Garden at Kakamega Forest, Kenya

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On a worldwide scale there is evidence for a severe pollinator decline which may cause problems for nature as well as for mankind, by, e.g., affecting the maintenance of biodiversity or by reduction of food production. Several scientific projects, among them the Biodiversity Monitoring Transect Analysis in Africa (BI-OTA) project of the German Ministry of Education and Research, are trying to assess the reasons, effects and consequences of those problems. Additional to research, it is also necessary to transform this knowledge to bring it into the public.

Many people are hardly aware of the crucial role that pollination plays, but public awareness is a basic requirement for a sustainable use of nature and, in this case, for a sustainable use of pollination. Sensitized for the importance and equipped with knowledge about plant-pollinator interactions, there is a chance that proper actions can be taken by the people, helping to protect pollinators and optimise food production.

Following the example of the Pollination Gardens at the Sonoran Desert Museum, Arizona, the yet-to-build Kakamegan Pollinator Garden is designed to raise awareness on the importance of plant-pollinator interactions. Located in the Western Province of Kenya at an altitude of about 1600 m, the Kakamega Forest represents a biologically highly diverse rainforest remnant, that is surrounded by a densely populated agricultural area.

In the garden, plant-pollinator interactions will be demonstrated using local wild and cultivated plants. It will be separated into 6 different topics: 1-Pollination, what is it for?, 2-Pollinating agents, 3-Pollination mechanisms, 4-"The Pollinator city", 5-Hand in hand with pollinators, 6-Domestic bees. Each topic consists of several stations that address several aspects of pollination. They are outfitted with plates, models and proper plants. Many stations provide the visitor with opportunities to interact. As the main target group are pupils, the knowledge is correspondingly transponded. However, the garden will also be arranged for students, tourists and, most importantly, for the local people.

P10.5

Root systems in an Ecuadorian tropical montane forest: The impact of altitude on nutrient acquisition and anchorage

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The extension of tropical montane forests over large altitudinal gradients leads to a pronounced heterogeneity in climatic conditions. Generally, temperature decreases whereas precipitation, cloudiness and wind speeds increase with increasing altitude. We investigated the impact of increasing altitude on the two major functions of root systems – nutrient acquisition and anchorage – in a South Ecuadorian montane forest. With increasing altitude, the organic surface layer became more important for nutrient acquisition. The percentage of total root length in the organic layer increased from 51 % at 1900 m to 61 % at 2400 m and 76 % at 3000 m. In mineral soil the decrease of root length densities (RLD) was sharper at the upper two study sites than at 1900 m. At 2400 m and 3000 m, RLD decreased to a value below 0.5 cm cm^{-3} at soil depths below 0.1 and 0.3 m, respectively. At 1900 m, RLD fell below 0.5 cm cm^{-3} only at 0.7-0.9 m soil depth. Accordingly, plants growing at 1900 m still obtained nitrogen from 0.4 m depth of mineral soil, whereas at 3000 m N-uptake from this soil depth was negligible. Also coarse root systems, the most important root component for anchorage, were more superficial at 3000 m than at 1900 m. At 1900 m 20% of the coarse roots originated from the stem base in mineral soil, whereas at 3000 m root origin was restricted to the organic surface layer. At 1900 m tap roots reached 0.5-0.8 m depth of mineral soil, at 3000 m tap roots penetrated only the organic surface layer. Root traits that improved the horizontal extension of the root-soil plate (root system asymmetry, low numbers of dominant roots) were more pronounced at 3000 than at 1900 m. It could be shown that at lower altitudes the mineral soil contributed more to nutrient acquisition and anchorage than at higher altitudes.

P11.7

Influence of microclimate change on ant communities in litter habitats along a tropical land use gradient from cacao plantations to natural forest

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Ants are the most abundant arthropods in tropical rain forests. As top predators in the tropical soil food-web and decomposers of dead organic material they play an important part in carbon-turnover. Agricultural land-use like plantation farming influences the natural ant community due to the change of the microclimate caused by the loss of natural vegetation and different shade situations in plantations. This study examines the effect of land use change (natural forest to cacao plantation) and different shade treatments on ant diversity and ant abundance in Central Sulawesi.

To examine the influence of the microclimate change, we set up water permeable shade-roofs at two different areas: cacao plantation under natural forest trees and cacao plantation under planted shade trees while the natural forest with permanent shade served as a control.

During the month of shade manipulation, ant activity was measured in the natural forest and in shaded and non-shaded control plots of the plantations using fish and honey baits. To estimate activity, the baits were offered for 20 minutes and ants feeding on the bait were collected and stored in 70% ethanol. Animals were counted and identified to species/morphospecies level. Data were analysed for morning and afternoon baiting separately.

In total we differentiated 44 types of morphospecies. Ant activity was higher in plantations under planted shade trees than in natural forest or plantations under natural forest and natural shade from overstorey as well as experimentally shaded patches in cacao plantations resulted in higher afternoon activities of ants. These findings indicated that with decreasing canopy opening the increased litter temperature stimulates ant activity only up to certain levels. Ants prefer open habitats, but high temperatures in the afternoon seem to limit ant activity in plantations.

The highest number of ant morphospecies was found in plantations under planted shade trees (29 m.-species) and natural forest (24 m.-species). While some ant morphospecies were active in all study sites, only two species were dominant in the natural forest. These two morphospecies were only found in small numbers in the plantations while several different species were dominant in the plantation under planted shade trees. The plantations under natural forest had an intermediate position regarding ant diversity and activity. Our data suggest that high diversity in microclimatic conditions and habitat structure can lead to increased ant diversity and activity, indicating that agroforestry systems can maintain high biodiversity.

P12.7

Impact of habitat fragmentation on leaf litter frogs of the Mata Atlântica in the state of São Paulo, Brazil

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The Mata Atlântica is one of the hotspots of biodiversity in the world. It is located along the coast of Brazil from south of the Amazon Basin until the far south of Brazil and in parts until north of Argentina. While about 60 % of the Brazilian population lives within the area of the Mata Atlântica it is unfortunately also one of world's hotspots of biodiversity loss. In the state of São Paulo there is only 7 % of the Mata Atlântica remaining. The remaining forest is highly fragmented through farm land, roads or populated area.

As part of an international cooperation between Brazil and Germany the presented project studies the impact of habitat fragmentation on population dynamics of selected leaf litter frog species. Comparing capture-mark-recapture studies were carried out on three amphibian species during the raining seasons 2003/2004 and 2004/2005. The three selected species (*Bufo ornatus*, *Eleuterodactylus guentheri*, *Eleuterodactylus parvus*) represented one generalist and two specialist species, limited on forest habitats and were captured in small forest fragments (less than five ha) with different degree of isolation and a control area inside the Morro Grande Forest Reserve. All study sites were located in secondary forest.

While specialist species showed a significant higher abundance in small isolated forest fragments (*E. guentheri*) or were found only in small isolated fragments (*E. parvus*), the abundance of the generalist species *Bufo ornatus* had no significant difference between continuous and fragmented habitats. The high abundance of specialist species in fragmented isolated habitat patches comes along with higher survival rates in these habitats than in the continuous forest or the connected patch. These results do not correlate with condition data. All studied species show no effect of fragmentation on body condition at all. Population size as well as species survival of specialist amphibian species seem to be positively affected by fragmentation.

P12.5

Optimization of plant propagation of native tree species of a mountain rain forest in South Ecuador

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More than 20000 seeds of ten selected native tree species *Cedrela montana*, *Clethra revoluta*, *Heliocarpus americanus*, *Hyeronima asperifolia*, *Inga acreana*, *Myrica pubescens*, *Nectandra membranacea*, *Piptocoma discolor*, *Tabebuia chrysantha*, and *Vismia tomentosa* were collected in the Reserve of Estación Científica San Francisco and sown in the experimental nursery in Loja. The influence of seven different substrates and three states of seed ripening on the germination was tested in an experimental split-plot-design. Results over all treatments show that the highest germination percentage was achieved by *Cedrela montana* (Ø 80%), followed by *Inga acreana* (Ø 62%), *Tabebuia chrysantha* (Ø 60%), and *Nectandra laevis* (Ø 52%). *Vismia tomentosa*, *Myrica pubescens* and *Piptocoma discolor* were lowest in germination with a mean percentage lower than 20%. Five of the ten selected species germinated best in pure humus from natural forests. Another three species preferred a substrate combined with moss cover. Regarding the different states of seed maturity eight of ten species showed highest germination after full ripening. In two species, *Clethra revoluta* and *Tabebuia chrysantha*, germination from a premature (green) stadium performed highest. This allows harvesting before the winged seeds are blown away. The findings are discussed in comparison with previous results from our and other working groups and will flow into recommendations for seed collection and management as well as into protocols for high quality mass propagation.

P13.1

Global decline of amphibians: Insights and perspectives from Monteverde

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Extinction can be a naturally occurring process. However, current extinction rates are estimated to be 100 to 1,000 times higher than expected in the 26,000 extant species of terrestrial vertebrates described. As of December 2005, the Alliance for Zero Extinction (AZE), a global initiative of 52 biodiversity conservation organizations, estimates that 49% of the most critically endangered species in 595 focal sites are found in the Neotropics, 51% of which are amphibians (AZE 2005).

Anuran decline on a global scale was first realized in the early 1990's. Despite extensive efforts, the causes for a continuing series of dramatic population crashes affecting several continents are still poorly understood. The causes appear to be multi-faceted: Climatic change, habitat destruction, predators, parasites, pathogens, introduced species, UV-B radiation, and any combination of these factors (Pounds 2001), giving rise to the 'synergism theory'. In some localities, research has identified the immediate cause of death, which often points to the parasitic fungus chytrid (*Batrachochytrium dendrobatidis*) or habitat loss, yet most likely factors are interacting to diminish amphibian resistance and finally cause mass mortalities. A particularly well-know example is the extinction of the golden toad (*Bufo periglenes*) and to date the decline of over 20 other anuran species in the Monteverde cloud forest area, Costa Rica (Pounds and Crump 1994; Pounds and Puschendorf 2004). The Monteverde area is located in a high altitude montane forest often considered pristine, and has attracted research into its ecology since 1970.

We investigate the research into factors leading to the extinctions observed in Monteverde and in particular the evidence presented to date linking amphibian declines to climate change. Data and models indicate that anuran diversity in Monteverde is threatened substantially by rapid change in environmental conditions. The unique long-term background data from Monteverde may not only provide important lessons for understanding the ongoing crisis, but also prove outstandingly valuable for future research into the causes and consequences of the global anuran decline. A coordination of such efforts, utilizing the Amphibian Populations Task Force as a common forum, is of critical importance at this stage to understand interdependencies of factors involved and increase pressure on policy makers.

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P1.3

Establishment of a tree nursery at Kakamega Forest, Kenya

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The Kakamega Forest is the easternmost remnant of the Guineo-Congolian rainforest that stretched in a belt from the Democratic Republic of Congo, Uganda up to Western Kenya. It contains a unique flora and fauna and is known for its bird, butterfly and primate watching sites.

However, at the same time the Kakamega region supports one of the highest rural population densities and population growth rates. Therefore, this valuable and unique forest is highly threatened due to encroachment for new land for agriculture and settlement and over-harvesting of forest resources. Due to this human pressure, half of the forest has been lost in the past 38 years and only 230 sq km is remaining. Although parts of the forest are gazetted since 1985 partly as Forest Reserve and partly as National Reserve, the forest still shows signs of a high level of human impact, illegal logging being the most widespread.

To counteract this loss of biodiversity a tree nursery was established in november 2004 at the KEEP office at the northern part of the Kakamega Forest (Buyangu site). In summer 2005 a greenhouse was build to improve the facilities for seedling growth.

KEEP is the Kakamega Environmental Education Programme, a community based organization (CBO). It was founded 1995 by forest guides to share their knowledge of the forest not only with tourists and researchers, but also with local school children. Although KEEP started as a purely educational programme for school children, it has now developed to incorporate many practical conservation measures and income generating projects.

One of those conservation projects is the new established tree nursery at the Buyango site. The tree nursery serves different aims at the same time: 1) it gives KEEP and its members a source of income by selling the tree saplings to local people, 2) providing tree saplings for enrichment planting, 3) providing tree saplings for planting of indigenous tree species on farmland and in hedges (on farm forestry), 4) providing seedlings and saplings of indigenous tree species for scientific experiments for researchers.

By focusing on the needs of the local community (firewood and medicinal plants) and on indigenous plants together with the educational efforts of KEEP, the human pressure onto the Kakamega Forest could be reduced.

P10.9

Spatial patterns of tree community-environment relationship in Bolivian lowland forests

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Understanding the factors that control changes in tree-species composition across spatial scales is of long-standing concern in ecology, and has profound consequences for forest management and conservation. Tree species differ in their tolerance to and requirements of the environment, resulting in differentiating distribution patterns along environmental gradients. As a result, community composition and structure varies along these gradients. Species richness, for instance, is generally higher in high-rainfall areas and at low latitudes, while relationships with soil fertility are ambiguous. Whereas local scale as well as continental scale patterns are well developed, studies on the mesoscale have received very little attention.

Bolivia provides an appropriate system to study vegetation-environment relationships because it features an extraordinary display of vegetation types, geomorphologic complexity and soil heterogeneity across a broad rainfall gradient.

This research proposes to (1) quantify species diversity, composition and forest structure along climate and soil gradients; (2) evaluate forest dynamic along these gradients in terms of abundance, recruitment, growth and mortality of the tree community; and (3) formulate recommendations for forest management based on species abundance and growth and dynamics for each forest type.

To address these objectives data from a network of 250 one-ha permanent sample plots distributed on Bolivian lowland forests will be used, which have been censused more than once. All trees ≥ 10 cm in diameter at breast height in each plot have been mapped, tagged, measured for their diameter, identified as far as possible and monitored for several years. Liana infestation, crown form and position, and tree health have been also considerate. Around 100 plots will be re-measured during two years of fieldwork. For each plot soil samples will be collected in the field and climatic data (precipitation, temperature) will be obtained from existing digital data sets and meteorological stations. Unknown plant species will be collected and identified in different herbaria.

This study will reveal the dynamics of Bolivian forests, and will maximize the knowledge of their species diversity, composition and structure along the major environmental gradients. The research will address long-standing questions about factors controlling the diversity, abundance, and distribution of tree species in forest communities considering a broader region and a much larger dataset than previous studies. Finally, results obtained will provide technical guidelines for such a stratified forest management, tailored to ecosystem characteristics and species traits.

P7.6

Estimating leaf area index of dense tropical forests using optical earth observation data: Prediction capabilities of spectral indices and artificial neural networks

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Leaf area index (LAI) is a key environmental variable that constitutes an important input to various ecosystem productivity models as well as global models in hydrology, climatology and biogeochemistry. The application of such models is largely influenced by the availability and quality of the input data. Knowing the spatial distribution of leaf area index is crucial in order to accurately determine ecosystem productivity and health. Spaceborne earth observation data is the principal means to estimate and map biophysical variables at a variety of different scales, both spatially and temporally. It is the only method of obtaining continuous spatial information on important biophysical variables such as canopy gap fraction and leaf area index.

Empirical LAI models based on spectral measurements from spaceborne platforms require an adequate number of in-situ observations. Since direct measurements of leaf area index through destructive harvest are impractical and undesirable in natural tropical forests, indirect methods for estimating LAI are required. Gap fraction analysis based on hemispherical photography is an indirect method of estimating LAI that has gained in importance over the last decade. Recent advances in instrumentation and the improvement of gap fraction inversion models, from which biophysical characteristics such as leaf area index and mean leaf inclination angle can be inferred, have increased the attractiveness of this technique.

This study evaluated various predictive models between atmospherically and topographically corrected spaceborne earth observation data and in-situ measurements of biophysical forest stand variables for a study area in Central Sulawesi, Indonesia. Gap fraction and leaf area index were calculated from digital hemispherical photographs which were collected from 95 GPS-registered plots.

Regression analysis included single and multiple spectral bands and band transformations.

As an additional inversion technique, artificial neural networks (ANNs) using non-linear transfer functions have been explored to infer leaf area index from remotely sensed data. In order to estimate the prediction and generalization power of the inversion, standard cross-validation techniques and sensitivity analysis were applied.

Due to saturation effects at high levels of vegetation abundance, the predictive capability of the commonly used NDVI is limited at $LAI > 4$. Results show that biophysical variables of tropical forests are better predicted using a combination of visible and middle-infrared wavelengths. Although more time-consuming in application, artificial neural networks which consider the full spectral range of optical remote sensing data can further increase the accuracy of the parameter estimation.

P8.5

Arbuscular mycorrhizae from arid sites in the summer- and winter rainfall area of Southern Africa

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Arbuscular mycorrhizae (Glomeromycota) were studied at four arid sites in Southern Africa. Two sites are located in the Nama Karoo, a summer rainfall area in Southern Namibia. The other two sites are situated in upland succulent Karoo vegetation, part of the winter rainfall area in north western South Africa. Mean annual rainfall at all sites is 150 mm. In both rainfall areas, sites under communal and commercial management are included and the sites under communal management are much more heavily grazed than the sites under commercial management, leading to different plant communities on the sites.

Both in the summer and winter rainfall area, arbuscular mycorrhizal spore communities are species-poor.

In the winter rainfall area, mycorrhization of Asteraceae and number of spores are not different. Looking at the distribution of morphological species, more occur on the heavily grazed communal land than on the commercial farmland. This is striking since the dominant shrub on the communal land is *Galenia africana* (Aizoaceae), belonging to a family that usually does not support mycorrhizae. When the ribosomal genes of Glomeromycota in roots were analysed, most sequences were detected within the roots of the Aizoaceae.

In the summer rainfall area, heavy grazing reduces mycorrhization rate of grasses but does not influence either morphological species diversity or spore occurrence. In this area, molecular analyses of the AMF community in roots show that morphological species and identification of sequences found in root samples (using BLAST search of GenBank) did not tally. Despite the differences in mycorrhization rate, the species community within the roots is largely identical. We therefore assume that differences in land management (heavy vs. moderate grazing pressure) are not strong enough to influence AMF species occurrence.

P10.3

Grazing gradients in a semiarid dwarf shrub savanna - test of plant functional type hypothesis in the Rehoboth farmlands (Namibia)

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In the Rehoboth farmland area historical and current development resulted in a landscape characterised by a mosaic of farms of different sizes and with different ownership structures. The socioeconomic background causes differences in land use, with distinct pasture management types as main feature. As a consequence fence line contrasts caused by different grazing regimes are visible signs for differences in past or present land use management.

Vegetation composition and a set of plant functional traits are measured along linear gradients of grazing pressure around permanent watering points and on two neighbouring farms with a strong fence line contrast (BIOTA Southern Africa Observatories Narais and Duruchaus). Responses of species and functional traits are tested to characterise vegetation changes under different grazing pressure. To test the validity of the trait set selected key species will be employed to cross-check the consistency of response to grazing by comparing the fence line contrast and gradients along transects.

P10.12

Phenology and pollination success in Apocynaceae-Asclepiadoideae in southern Ecuador

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Analysis of plant-pollinator interactions is fundamental for the understanding of montane rainforest ecosystems. Most investigations on the reproductive biology of tropical plants focus on specialized animal-plant interactions and conspicuous flowers. Less specialized interactions and inconspicuous flowers have received little attention. This paper studies phenology and pollination ecology of nine small-flowered neotropical species of „*Cynanchum*“, *Ditassa*, *Jobinia*, *Oxypetalum* and *Scyphostelma* (tribe Asclepiadeae). Their many-flowered inflorescences typically bloom simultaneously, which is important in the attraction of insect visitors. Numerous kinds of floral visitors were observed, however, pollinaria were carried only by three insect species. The flowers show a comparatively low pollinaria removal rate with an average of 0.32 ± 0.13 , and an even lower average was recorded for the pollinia insertion rate 0.13 ± 0.07 . The percentage of inserted pollinia to removed pollinaria is comparatively high with an average of $42.7\% \pm 22.3\%$. Floral longevity varies between three to five days and floral longevity is shortened by successful pollinia insertion. This shows that if an insect did achieve pollinia transfer, they did it very effectively. The complex floral morphology of the Asclepiadoideae has often been interpreted as a general trend toward specialization, but observations of pollination indicate at least some degree of generalization.

P2.2

Above- and Belowground CO₂-Losses of Woody Organs along an Altitudinal Gradient of a Tropical Mountain Rainforest in South-Ecuador

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Profound information is missing about CO₂-losses of above- and belowground organs of tropical mountain rainforests. Preliminary studies of the biomass of mountain forests in South-Ecuador have shown that aboveground phytomass production is decreasing from 1050 m to 3060 m asl. by a factor of 20. At the same time, photosynthesis is probably not declining proportionally. This phenomenon lead to the question, if the CO₂-release along an altitudinal gradient is in fact correlated with the decreasing temperature or if increasing environmental stress at upper sea levels is the factor for compensatory woody tissue respiration.

We choose three forest stands at 1050 m, 1890 m and 3060 m asl for diurnal and seasonal measurements of apparent CO₂ release rates of roots and aboveground woody organs. For quantifying the gas exchange we use Plexiglass-cuvettes and an automatic respiration system (Firma Walz, Effeltrich, Germany). This system allows for continuing diurnal recording of the CO₂-exchange of six cuvettes running in parallel. Measurements started in July 2005 and will continue until August 2006. Four measurement cycles on selected tree individuals from the most representative species will be carried out within one year to cover seasonal variation in gas exchange along the altitudinal gradient.

Multiple regression analyses of the data will help to determine driving environmental factors. Carbon release models will be developed for individual tree species and forest stands. The expected results will contribute to the functional understanding of tropical mountain forests as well as supply valuable data for C-turnover modelling in tropical ecosystems.

P11.5

Variation of Flora, Soils and Vegetation in a Montane Rain Forest (Yuracyacu Valley, Alto Mayo, N-Perú)

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The Alto Mayo Valley in Northern Perú (Department San Martín) is located on the Subandean Belt of the Eastern Andes (Cordillera Oriental). While the valley floor is almost completely cleared from pristine vegetation and is under intensified agricultural use (esp. rice production), remain the surrounding valleys of the Alto Mayo river tributaries with less or non-impacted primary montane rainforests. These areas play an important role for the water supply of both, the settlements and the rice cultivation. Therefore parts of the Cordillera Oriental in the Alto Mayo region have been proclaimed as a national forest sanctuary, the *Bosque de Protección Alto Mayo*.

In our study we examined the middle part (1300 - 2000 m a.s.l.) of the Yuracyacu watershed ranging from 820 m a.s.l. at the mouth to the Alto Mayo River to 3200 m a.s.l.. It is located in the *Bosque de Protección Alto Mayo*, approx. 40 km to the west of department capital Moyobamba. Research objective was on one hand the description of Flora, Vegetation and Soils in the study area. On the other hand we analyzed response of recorded parameters to altitude and how variation can be explained.

A total of 18 sites were surveyed with elevation between 1359 m and 2028 m a.s.l.. In 0.01 ha plots trees with DBH > 10 cm have been completely determined to genus level, where possible to species level. Vegetation was described by forest inventory method with a mirror relascope in order to determine basal area and, as a representative sample, stem density, DBH, altitude and genus (where possible species) of individuals. Edaphic situation on every site was observed by field description and laboratory analytics of chemical properties.

Out of a total of 487 collected specimens the taxonomic families *Lauraceae*, *Rubiaceae* and *Moraceae* were found most frequently. Just a few palm-individuals could be found on the lower part of the slope while the occurrence of tree ferns (*Cyatheaceae*) inclines with altitude. Species turn over could not be explained sufficiently by altitude.

Dendrometric measurement showed that mean stand height decline slightly with altitude. Basal area range from 13 to 34.5 with an average of 26.25 m²ha⁻¹. Similar results could be found in other forest of the Alto Mayo region.

Generally soils are of moderate depth which suggests that weathering dominates eroding factors. On the less inclined upper sites hydromorphic features could be observed. Texture was characterized by clayic to silty material. Just in a few cases ECEC exceeds 16 cmolc/kg while base saturation is in general high. Neither Al toxicity nor lack of plant available P play a role on the examined sites.

P6.8

Spatial and temporal variability of soil saturated hydraulic conductivity.

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Land use change in the humid tropics causes the alteration of soil hydraulic parameters including a possible change of near surface flow paths. While the effect of disturbances has already been investigated to some degree, the regeneration process after disturbance is still poorly understood; this is particularly true for ecosystems that are hardly accessible. In southern Ecuador, the montane rain forest ecosystem is subject to natural disturbances in the form of landslides, and human interventions, mainly forest conversion for pasture purposes. In both cases, disturbance – induced land covers are of short existence in time due to the invasion of succession vegetation which emerges either because of missing slide activity or pasture abandonment.

Soil saturated hydraulic conductivity (Ksat) is a good indicator for the assessment of those changes because it translates the easily detectable landscape pattern into the soil. For the quantification of different types of natural, disturbance and post – disturbance land covers regarding Ksat, we measure the field – saturated hydraulic conductivity at soil depths of 12.5, 20, and 50 cm under landslides of different ages ranging from 0 to 30 years, under actively grazed pasture, fallows following pasture abandonment of 2 to 25 years of age, and under natural forest. The results can be related to frequent rainfall intensities to diagnose the possible occurrence of an impeding layer at a shallow soil depth, which may cause perched water tables and saturation excess overland flow.

Results from the human – induced disturbance regime show an enormous decrease of Ksat after forest conversion to pasture at shallow soil depths, and a slow regeneration after pasture abandonment. However, the reduced permeability hardly causes an alteration of subsurface flow paths: since rainfall intensities are low for the majority of storm events in the research area, a perched water table is unlikely to form regardless of land cover.

Field work recently concentrates on the landslides and will be finished in December 2005.

P12.9

Tree transpiration in the dry forests of North-West Peru

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The coastal foothills of the Cordillera in North Peru are covered by open, mainly deciduous dry forests. The proximity to the cold Peru-current and the warm equatorial current causes a highly variable precipitation regime. To cope with the often unpredictable seasonal rain water availability during the short rain season peaking in March, all tree species of the dry forests must have developed strategies to survive water scarcity over long periods.

We investigate the water uptake patterns, water storage capacity and transpiration control in the most common evergreen and deciduous tree species of the dry forest. The study area is a transition from thorn savanna like forest to lower montane dry forest located in the National Game Reserve of "El Angolo" in north Peru. Since 2004/2005 we monitor site climate, soil humidity and xylem sap flux of 27 trees at three site locations.

Tree sap flux of most species is not correlated with annual climate patterns. Only two tree species studied, "Pasallo" (*Eriotheca ruizii*) and to a lesser degree "Charan" (*Caesalpinia paipai*) show increasing water consumption following soil water recharge after the rain season. Some tree species, e.g. "Ceibo" (*Ceiba trichistan-dra*), depend primarily on stem water storage and recharge during the rainy season. "Ceibo" and "Palo Santo" (*Bursera graveolens*) have paradoxically their highest water consumption during the end of the dry season. Water consumption by trees is in most deciduous species not limited to the leaf-on period. Daily patterns of deciduous tree xylem flux vary widely and are often completely decoupled from atmospheric vapour pressure deficit (VPD) and solar radiation. Most species in the dry forest are deciduous. However, water loss is not reduced to zero during the leafless period. During many dry months of the year, most tree species show xylem water flux peaks during late evenings or early night. This is indicating strong stomatal control and CAM/C3 pathway shifts. In some tree species no leaves are present during the apparent night transpiration measured and stem CAM is suspected.

P1.5

Specific attraction to tibial fragrances in male orchid bees and the question of leks

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Male Orchid Bees (*Euglossini*) collect volatile substances (fragrances) from flowers and other sources and store them in hind tibial pouches. A complex bouquet is accumulating there, which has previously been found to be chemically species-specific in the genus *Euglossa* (Eltz et al., 2005a). Also in *Euglossa*, the fragrances are known to be exposed and ventilated by males during their courtship display (Eltz et al., 2005b). Two species of the related genus *Eulaema*, *E. meriana* and *E. bombiformis*, showed similar display behaviour while perching at tree trunks in the forest understorey on Barro Colorado Island in Panama. The two species displayed sympatrically, but used trees of different diameter as display sites. Here they patrolled the immediate surroundings of their perch, regularly landed on the tree and buzzed their wings while sitting on the bark. Doing so, the males were frequently oriented towards the direction of the wind. When conspecific males entered the territory they interacted until one of the males left. We investigated whether the fragrance bouquet in *Eulaema* hind tibiae mediates remote attraction of conspecifics. We exposed hindleg extracts of the two species (alternately) on filter pads tagged to active, but presently vacant display trees. Up to four males were attracted within 10 minutes after exposure, but none came to hexane controls. Males were only attracted to their own species' hindleg extract. Females were not seen on those occasions. Attraction of males was dependent on the display context, i.e. exposure of extracts at non-display trees and in non-display areas was less effective. Our findings strengthen the idea that complex tibial odors may function as species-specific attractants in a courtship context. However, whether males or females are the primary addressee remains unclear. Males attraction to tibial odors could lead to aggregation of display sites in certain areas, e.g. on hill tops as in the present case, thus creating a lek situation for choosy females.

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P6.4

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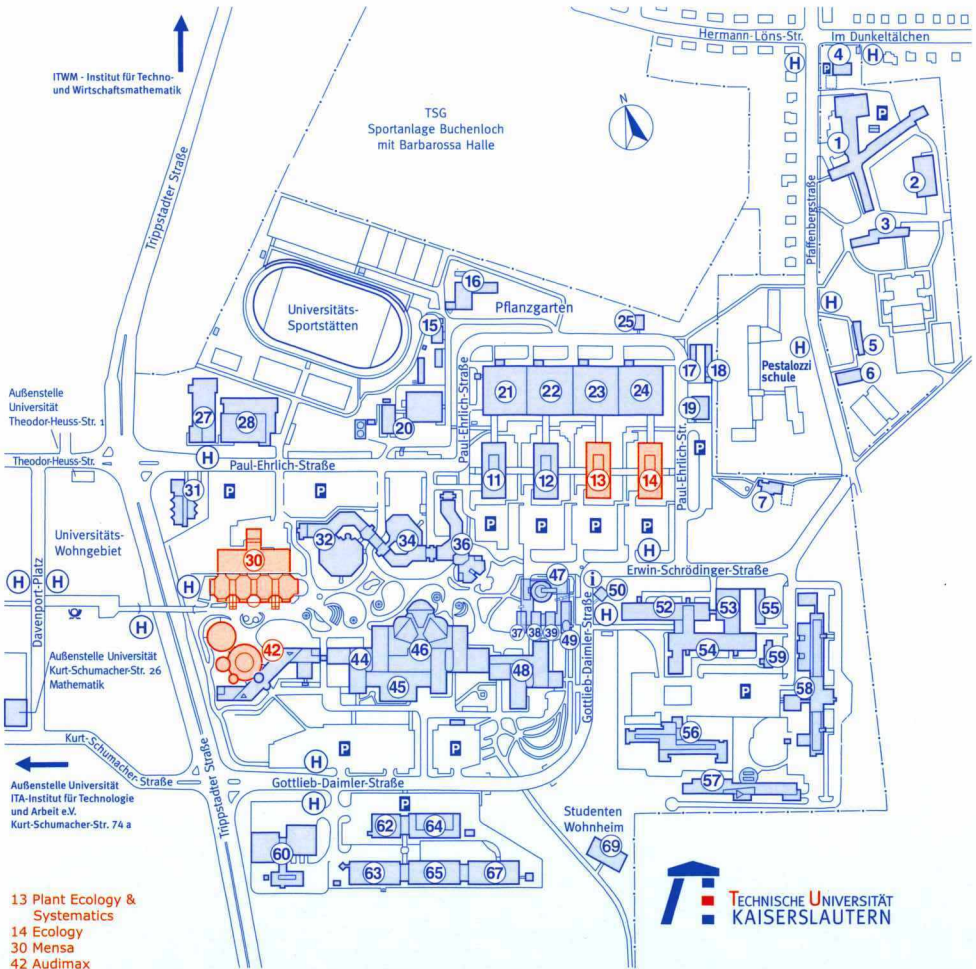
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Time	Tu 21 Feb 06	We 22 Feb 2006		Th 23 Feb 2006		Fr 24 Feb 2006	
	Human impact & global change	Organism interactions		Biodiversity		Human impact & conservation	
		8:30-09:15 Plenary Oliveira		8:30-09:15 Plenary Gradstein			
0900	09:00-14:00 Registration, Handing in Talks, Setting up Posters DFG-Meeting of Research Unit 402 (Build. 57, Rotunde)	09:15-10:00 Session 3		09:15-10:00 Plenary Hofmann		9:00-09:45 Plenary Tschardtke	
1000		10:00-10:30 Coffee break		10:00-11:30 Coffee break		09:45-10:30 Session 12	
1100		10:30-12:00 Session 2		10:30-12:00 Session 7		10:30-11:00 Coffee break	
1200		Poster presentation Sessions 1 to 7		Poster presentation Sessions 8 to 13		11:00- 12:30 Session 12	11:00- 12:30 Session 13
1300		12:30-13:30 Lunch		12:30-13:30 Lunch		12:30-13:00 Closing Ceremony	
		13:30-14:30 Postersession 1		13:30-14:30 Postersession 2		13:00 Lunch & Departure	
1400		14:00-14:45 Opening Cere- mony			14:30- 16:00 Session 8	14:30- 16:30 Session 10	14:00-17:00 ISPRS-workshop on Remote Sensing in the Tropics
1500	14:45-15:30 Plenary Baker	14:30- 16:00 Session 4	14:30- 16:00 Session 6				
	15:30-16:00 Coffee break						
1600	16:00-18:00 Session 1	16:00-16:30 Coffee break		16:30-17:00 Coffee break			
1700		16:30- 18:00 Session 5	16:30- 18:00 Sessions 6 & 9	17:00-18:30 Annual Meeting GTÖ		17:00 Departure	
1800		18:00 – 20:00 Posterparty					
1900	19:00 Welcome at the Exhibition Opening						
2000		20:00 Evening Lecture		20:00 Conference Dinner			



Organized by:

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