Society for Tropical Ecology / Gesellschaft für Tropenökologie

gtö

18th annual Conference

»Tropical ecosystems: functional biodiversity & human influence«

22-25 February 2005

Program & Abstracts

Institute for
Zoo & Wildlife
Research (IZW)

museum für naturkunde
Humboldt-Universität zu Berlin

Edited by Heribert Hofer (IZW), Ulrich Zeller and Kathrin Thiele (MfN)

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Welcome to Berlin

18th Conference: "Tropical ecosystems: Functional biodiversity and human influence" Berlin 22 - 25 February 2005

On behalf of the Society for Tropical Ecology we welcome the participants of the 18th Annual Conference of the Society on "Tropical ecosystems: Functional biodiversity and human influence" in Berlin.

The focus of the conference are symposia on the following topics:

- Human resource use of tropical ecosystems: patterns, conflicts and conservation issues.
- Connectivity between tropical and temperate ecosystems: from climate and fluxes to migrations.
- Tropical and subtropical savannas.
- Species interactions (coexistence, mutualism, competition, herbivory, predation, parasitism).
- Free topics.

The Conference is held in the centre of Berlin at the Agricultural Faculty of the Humboldt University. We have an action-packed scientific programme supplemented by an evening programme that should keep you busy for most of the four conference days.

Scientific program

- The conference language will be English.
- Tuesday 22nd February will be the day of arrival, registration, setting up of posters and a welcome evening (ice-breaker).
- The scientific program will cover three days (Wednesday 23rd February 2005 till Friday afternoon 25th February 2005). The prizes will be awarded by the President of the Society for Tropical Ecology during the closing ceremony at 4pm on Friday 25th February 2005.
- Following the decision by the official annual meeting of the society in Bayreuth in February 2004, we will have parallel oral sessions for the first time at an annual meeting of the society. As you will see in the schedule outlined below.
- Thus, there will be three different forms of presentations: (plenary) oral contributions, oral contributions in parallel sessions and posters. Oral presentations are allocated to plenary or parallel sessions at the organisers' discretion.
- We have made a particular effort to provide maximum exposure for poster authors (and their scientific contributions). Firstly, a **poster party** on Wednesday night (with drinks and food supplied) will provide an informative setting to approach both posters and author(s). Secondly, on Thursday, those poster authors who have expressed an interest when submitting their abstract to do so will have the opportunity to give a **1-min introduction to their poster to the plenary audience**. Finally, a **special poster viewing session** will take place on Friday, and extended lunch breaks will provide

additional poster viewing time. The colored posternumbers are eligible for the Merain Price.

- Talks will be 12 min plus 3 min discussion and we assume that talks will be given using powerpoint presentation techniques unless indicated otherwise.

Opening Address

1. Bürgermeister von Berlin-Mitte: Herr Joachim Zeller, CDU
2. Dekan der Mathematisch-Naturwissenschaftlichen Fakultät I der Humboldt-Universität zu Berlin: Prof. Thomas Buckhout
3. Parlamentarische Staatssekretärin im Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung: Dr Uschi Eid
4. Leiter der Abteilung N (Naturschutz und nachhaltige Entwicklung), BMU: Herr Jochen Flasbarth
5. Präsident der GTÖ: Prof. Karl Eduard Linsenmair.

(Chairperson: Prof. Dr. Ulrich Zeller)

18th official annual membership meeting of the Society

The official annual membership meeting of the Society for Tropical Ecology (GTÖ) will take place in Lecture Hall 10 on Thursday, 24th February 2005, at 5 pm.

We are looking forward to welcoming you at the 18th Annual Conference on the 22nd of February 2005 in a sunny Berlin!

Heribert Hofer and Ulrich Zeller

Essential conference information

Conference Venue

A map of the conference venue is on the back of this volume !

The 18th Annual Meeting of the Society for Tropical Ecology is held on the Campus of the **Agricultural Faculty (Landwirtschaftlich-Gärtnerische Fakultät) of the Humboldt-Universität in Berlin Mitte** in the immediate vicinity of the **Museum of Natural History** (Museum für Naturkunde, Invalidenstr. 42/43).

All **plenary sessions will** be held in **Lecture Hall 10** at the rear of the campus opposite the Thaer Building, the **parallel oral sessions** will be held in **Lecture Halls 10** and **7**.

Registration and Conference Office, welcome evening, poster presentation, the poster party and the evening banquet (20,- p. p.) will take place in the **'Thaer-Hall'**. The Registration Desk and Conference Office will be open for registration from Tuesday, 22nd, 3.00 p.m. onwards. Meetings of the Advisory Board (Wissenschaftlicher Beirat) and the Executive Board (Präsidium) of the Society for Tropical Ecology will be held in **Lecture Hall 4** and in the **'Dekanatssaal' (R 1007)** of the 'Thaer-Building', respectively.

Transport

We strongly recommend **public transport** for travel within the city and to the conference venue, because there are only very limited car parking facilities and the public transport system in Berlin is excellent.

Arriving by plane: Arriving at Tegel airport, please take the Airport Express Bus TXL to Kurt-Schumacher-Platz, then change to the subway U6 in direction "Alt-Mariendorf". Exit the subway at "Zinnowitzer Strasse" and proceed to the **Museum für Naturkunde** and **Campus of the Agricultural Faculty** along Invalidenstrasse (5 min walk).

If you arrive at Airport "Schönefeld" take the Regional Express Train ("Airport Express Schönefeld") or the "S-Bahn" to "Friedrichstrasse". Then change to U6 subway in direction "Alt-Tegel" and exit either at "Zinnowitzer Str." for the Museum and Agricultural Faculty Campus (conference venue) or at "Oranienburger Strasse" if you stay at the guest house of the university (see below).

Arriving by railway: Exit at train station "Zoologischer Garten" and switch from the DB platform to the green S-Bahn platform, Take the S-Bahn to station "Friedrichstrasse". Then change to U6 subway in direction "Alt-Tegel" and exit either at "Oranienburger Strasse" for the guesthouse or at "Zinnowitzer Strasse" for the Museum and Agricultural Faculty Campus.

Guest house accommodation

A limited number of participants may have found accommodation at the **guest house of the university** within walking distance. The closest subway station to the guest house is "Oranienburger Strasse" (next stop after "Zinnowitzer Strasse"). The guest house itself is located at Ziegelstrasse 13, at the end of a narrow street, on the right side, just inside a driveway through the building, and some minutes walk from the large building of the musical theatre "Friedrichstadtpalast".
If everything fails, please contact
our secretariat office ++4930 2093-8794 or 2093-8563
Guest house: ++4930 2093 1186 or 2093-1187
Guard at the Museum: ++4930 2093 8591

Lunch

"Nord-Mensa", Reinhardtstr. 30, a recommended student eating facility of the Humboldt-University (10 min walk). As payment in cash is not possible in this Mensa, you can purchase an electronic payment mensa card at the "Nord Mensa".
"Bauernmensa" on the Campus of the Agricultural Faculty (limited capacity, 1 min walk)
Students: You will have to show a student identity card or a proof of your immatriculation in order to get student prices in the Mensa.
"Marcanns" – a recommended french patisserie at the corner of Chausseestrasse and Invalidenstrasse (5 min walk)
"Derja" – a Turkish restaurant at Chaussestr. 116 near the corner with Invalidenstrasse (5 min walk)
The **Cafeteria of the Museum of Natural History** at its main public entrance will be open too (1 min walk)

Other facilities

If you require medical assistance contact conference office. A pharmacy ('Apotheke') is found nearby at the Charité-Complex, Luisenstrasse 49-50.
A bank ('Sparkasse') is likewise situated nearby at Luisenstrasse 44.
For Taxi please call 44 33 22.

Guided tours

Because of urgent and essential reconstruction work, the **Museum of Natural History** might have reduced public access to its exhibition areas during the time of the conference. However, we will offer some guided tours to the collections and research departments for participants of the congress.

Organisation

Organisation Committee & Conference Management:

Prof. Dr. Ulrich Zeller
Museum für Naturkunde der Humboldt-Universität

Prof. Dr. Heribert Hofer
Leibnitz IInstitut für Zoo- und Wildtierforschung

Kathrin Thiele
Dr. Peter Bartsch
Nils Hoff
Dirk Striebing
Mike Schlott
Steven Seet
Gabriele Liebich

Dr. Stefan Holzheu
Bayreuth Center of Ecology and Environmental Research (BayCeer)

Dr. Alfred Bittner
FH Rottenburg/Präsidium der GTÖ

Chairs of Sessions and Symposia:

Prof. Dr. Siegmar Breckle
Dr. Hermann Ellenberg
Dr. Eckhard W. Heymann
Prof. Dr. Heribert Hofer
Prof. Dr. Elisabeth Kalko
Dr. Judith Korb
Prof. Dr. Karl Eduard Linsenmair
Dr. Pia Parolin
Dr. Frank Suhling
Dr. Marco Tschapka
Prof. Dr. Ulrich Zeller

Plenary Speakers:

Prof. Dr. Siegmar Breckle (Universität Bielefeld)
Prof. Dr. F. Göltenboth (Universität Stuttgart-Hohenheim)
Dr. Anja Lindstädter (Universität Köln)

Program

Time	Tue 22.02.2005	Wed 23.02.2005		Thu 24.02.2005	Fri 25.02.2005	
09:00 - 09:30	15:00 Registration, Setting up posters (Thaer Saal)	09:00-09:30 Opening ceremony* (HS10)		09:00-10:00 Plenary III (Breckle) (HS 10)		
09:30 - 10:00		09:30-10:30 Plenary I (Göltenboth) (HS 10)				
10:00 - 10:30				10:00-10:30 IV: Species interactions (HS 10)	10:00-11:00 Postersession/ Coffee break (Thaer-Saal)	
10:30 - 11:00		10:30-11:00 Coffee break (Thaer-Saal)		10:30-11:00 Coffee Break (Thaer-Saal)		
11:00 - 12:00		11:00-12:00 I: Human resource use (HS 10)		11:00-12:00 Introduction to Poster (oral)** (HS 10) 11:00-14:00 Advisory and Executive Board Meeting (HS 4)	11:00-12:30 VII: Human resource use (HS 10)	
12:00 - 12:30						
12:30 - 14:00		12:00-14:00 Lunch / Poster		12:00-14:00 Lunch / Poster	12:30-14:00 Lunch / Postersession	
14:00 - 15:00		14:00-15:00 Plenary II (Linstädter) (HS 10)		14:00-15:30 V: 6 Species interactions (HS 10)	14:00-16:00 VIIIa: Human resource use (HS 10)	14:00-16:00 VIIIb: Species inter-actions, Free topics (HS 7)
15:00 - 15:30		15:00-16:00 II: Savanna, Connecitivity (HS10)				
15:30 - 16:00				15:30-16:00 Coffee break (Thaer-Saal)		
16:00 - 16:30		16:00-16:30 Coffee break (Thaer- Saal)		16:00-17:00 VI: Species interactions (HS 10)	16:00-18:00 Prizes, closing address, Coffee break (HS 10 / Thaer-Saal)	
16:30 - 17:00						
17:00 - 18:30	17:00-19:00 Advisory Board Meeting (R 1007)	16:30-18:00 IIIa: Human resource use (HS 10)	16:30-18:00 IIIb: Free topics (HS 7)	17:00-18:30 Annual membership meeting Society for Tropical Ecology (HS 10)		
Evening	19:00-21:00 Welcome evening (Thaer-Saal)	20:00- 22:00 Posterparty (Thaer-Saal)		20:00-24:00 Banquet (Thaer-Saal)***		

* see page 2 ** see page 12 *** see page 3

Program: Oral presentations

(* eligible for the Merian Price)

Session I: Wednesday 23rd February 2005, 09:30-12:00

Chairperson: Prof. Dr. Ulrich Zeller

09:00-09:30	**Opening ceremony**	**Zeller, Buckhout, Eid, Flasbarth, Linsenmair**

Human resource use of tropical ecosystems: Patterns, conflicts and conservation issues

Chairperson: Prof. Dr. Ulrich Zeller

09:30-10:30	**PLENARY: "Rainforestation Farming" - an innovative application of the ecosystem approach in the Philippines**	**Göltenboth, F.**	**Hohenheim**

Chairperson: Dr. Hermann Ellenberg

11:00-11:15	Sustainable farming in the Amazon - is this possible?	**Lanfer, N.**	Berlin
11:15-11:30	Are there sharp elevational limits in vegetation composition in species-rich tropical montane could forests?	**Bach, K*.** Schawe, M., Gradstein, S. R., Gerold, G.	Göttingen, Marburg
11:30-11:45	Analysis of vertical nutrient pathways and impacts on Taï National Park due to cocoa production	**Fischer, E***, Kouadio, A., Biémi, J., Gerold, G.	Göttingen, Abidjan
11:45-12:00	Light management as a tool for conservation and sustainable management of Podocarpaceae in the buffer zone of Podocarpus National Park, southern Ecuador	**Günter, S.,** Calva, O. P., Beltran,G., Aguirre Z., Mosandl, R.	München, Loja

Session II: Wednesday 23rd February 2005, 15:00-16:00

Tropical and Suptropical Savannas

Chairperson: Prof. Dr. Ulrich Zeller

14:00-15:00	**PLENARY: Savannas and sustainability – Ecological and socio-economic criterions for a sustainable land use**	**Linstädter, A.**	**Köln**

Chairperson: Prof. Dr. Elisabeth Kalko

15:00-15:15	Population dynamics of an ecosystem engineer, the fungus cultivating termite *Macrotermes bellicosus* in West-Africa: analysis of a long-term study	**Korb, J.**	Regensburg
15:15-15:30	Impacts of land use strategies on species diversity and herbaceous biomass in the functional land use units of the Borana pastoral ecosystem, Ethiopia	**Dalle, G.**	Ethiopia

Connectivity between ecosystems

Chairperson: Prof. Dr. Elisabeth Kalko

15:30-15:45	Biomass burning in the amazon as fertilizer for tropical mountain forests?	**Rollenbeck, R.,** Fabian P., Bendix, J.	Göttingen, Marburg
15:45-16:00	Mixing Africa and Europe - speciation processes in grasshoppers from the Canary Islands	**Hochkirch, A.**	Osnabrück

Session III: Wednesday 23rd February 2005, 16:30-18:00

Parallel session A (HS 10):

Human resource use of tropical ecosystems: Patterns, conflicts and conservation issues

Chairperson: Dr. Judith Korb

16:30-16:45	Termite assemblages in a West-African semi-deciduous forest and teak plantations	Attignon, S. E., Lachat, T., Sinsin, B., Nagel, P., **Peveling, R.**	Cotonou, Basel
16:45-17:00	Relationship between soil properties and tree growth along an altitudinal transect in Ecuador	**Wilcke, W.**, Schmitt, A., Homeier, J., Valarezo, C., Zech, W.	Berlin, Bayreuth, Bielefeld, Loja
17:00-17:15	From forest to farmland: habitat effects on Afrotropical forest bird diversity	Waltert, M., Bobo, K. S., Fermon, H., Sainge, N.M., **Mühlenberg M.**	Göttingen, Korup
17:15-17:30	Analysing fragmentation and disturbance of East-African rainforests by means of remotely-sensed time series data and landscape metrics	Lung, T., **Schaab, G.**	Karlsruhe
17:30-17:45	Structural features of two rain forests in East Africa under different disturbance history - a comparison between the Budongo Forest, Uganda, and the Kakamega Forest, Kenya	**Gliniars, R.**, Uster, D., Musila, W., Todt, H., Dalitz, H.	Hohenheim, Nairobi
17:45-18:00	The composition of the plant communities of Kakamega Forest, Kenya - a first description and the role of anthropogenic influence	**Althof, A.**, Fischer, E.	Bielefeld, Koblenz

Parallel session B (HS 7):

Free topics

Chairperson: Dr. Marco Tschapka

16:30-16:45	The influence of altitude on plant nutrition in a tropical montane forest in Southern Ecuador	**Soethe, N.**, Lehmann, J., Engels, C.	Berlin
16:45-17:00	Bottom-up or top-down: a Case study on phasmids (Phasmatodea)	**Berger, J.***	Kaiserslautern
17:00-17:15	Nutritional differences and leaf acclimation of climbing plants and the associated vegetation in different types of an Andean montane rainforest	**Salzer, J.** & Kazda, M.	Ulm
17:15-17:30	Tropical cyanobacteria under extreme and highly fluctuating conditions	**Lakatos, M.**, Rascher, U., Dojani, S., Lakatos, T., Büdel, B.	Kaiserslautern, Jülich
17:30-17:45	Roost ecology and mating system of the white-throated round-eared bat *Lophostoma silvicolum*	**Dechmann, D .K. N.***, Kalko, E. K. V. , Kerth, G.	Zürich, Ulm, Balboa
17:45-18:00	Ecotypic differentiation versus phenotypic plasticity - variation in the eurytopic Amazonian millipede *Poratia obliterata* (Diplopoda: Pyrgodesmidae)	**Bergholz, N. G. R.***, Adis, J. U., Kömpf, J., Tomiuk, J., Mendes dos Santos, J. M.	Plön,Tübingen, Manaus

predation on larvae from same species

Session IV: Thursday 24 February 2005, 09:00-10:30

Species interactions

Chairperson: Prof. Dr. Heribert Hofer

09:00-10:00	PLENARY: Ecological Studies in the Tropics – past and future	Breckle, S. W.	Bielefeld
10:00-10:15	Canopy structure defines abiotic parameter in forests. Does it influence plant diversity?	**Oesker, M.**, Todt, H., Uster, D., Homeier, J., Dalitz, H.	Bielefeld, Hohenheim
10:15-10:30	Enhanced seed dispersal of *Prunus africana* in fragmented and disturbed forests	**Farwig, N.***, Böhning-Gaese, K., Bleher, B.	Mainz, Nairobi

Special session (HS 10): Thursday 24th February 2005, 11:00-12:00

Chairperson: Prof. Dr. Heribert Hofer

11:00-12:00	Short poster presentations	Variety of authors	Variety of locations

Session V: Thursday 24th February 2005, 14:00-15:30

Species interactions

Chairperson:Dr. Pia Parolin

14:00-14:15	Crucial "ecosystem services" delivered by flying foxes (Pteropodidae): Seed dispersal in fragmented landscapes in West Africa	**Ebigbo, N. M***, Fahr, J., Kalko, E. K. V.	Ulm
14:15-14:30	Effect of lactation on the nocturnal activity pattern of a small neotropical fruit bat, *Rhinophylla pumilio* (Carolliinae), in French Guiana	**Henry, M.**, Kalko, E. K. V.	Brunoy, Ulm
14:30-14:45	Ecology of the trumpet-nosed bat *Musonycteris harrisoni*, a specialized flower-visitor from the endangered dry forests of Western Mexico	**Tschapka, M**, Sperr, E, Caballero Martínez, L. A., Medellin, R. A.	Ulm, Mexico
14:45-15:00	Nectar sugar composition and nectar volumes of Gentianales from a southern Ecuadorian montane forest	**Wolff, D.**, Liede-Schumann, S.	Bayreuth
15:00-15:15	Triggered pollen presentation, timing and pollination in Loasaceae subfam. Loasoideae	**Henning, T.**, Weigend, M., Schneider, C.	Berlin
15:15-15:30	Inter- and intra-specific sharing of incubation mounds by megapodes: brood parasitism or communal nesting?	**Sinclair, J. R.**	Papua New Guinea

Session VI: Thursday 24th February 2005, 16:00-17:00

Species interactions

Chairperson: Dr. Eckhard W. Heymann

16:00-16:15	The importance of species interactions and ecological traits for regional distribution pattern of dragonflies in arid Namibia	**Suhling, F**rank	Braunschweig
16:15-16:30	Competing dragonfly species in a changing landscape	**Braune, E**rik	Braunschweig
16:30-16:45	Selecting the drought stressed: Effects of plant stress on intra-specific and intra-individual herbivory patterns of leaf-cutting ants	**Meyer, S.T.***, Roces, F., Wirth, R. Sebastian	Kaiserslautern, Würzburg

how do they migrate? cues? consequences for genetic diversity?

natural sequence of development?

16:45-17:00	What determines instar number in the grasshopper *Cornops aquaticum*, and the implications for its use as a biological control agent	**Brede, E.G*.**, Adis, J., Parolin, P., Junk, W.	Plön

17:00-18:30	**Annual membership meeting Society for Tropical Ecology (HS 10)**

Session VII: Friday 24th February 2005, 09:00-12:30

Human resource use of tropical ecosystems: Patterns, conflicts and conservation issues

Chairperson: Prof. Dr. Karl Eduard Linsenmair

11:00-11:15	Key processes for tree species richness in tropical rain forests	**Huth, A.**, Koehler, P.	Leipzig, Bremerhaven
11:15-11:30	The impact of land use on landscape heterogeneity and plant diversity - issues of scale	**König,S.**, *Schmidt, K., Hahn-Hadjali, K., Runge, J.	Frankfurt
11:30-11:45	Re-thinking Gap Analysis - a new approach to an old methodology	**Nowicki, C.**, Ibisch, P. L.	Eberswalde
11:45-12:00	Selection of conservation priority sites for the fragmented Atlantic Forest at the Plateau of São Paulo (Brazil)	**Felinks, B.***, Bernacci, L., Camargo Martensen, A., Catharino, E., Dixo, M., Metzger, J. P., Pardini, R.	Leipzig, São Paulo
12:00-12:15	Predicting areas of high conservation priority for West-African amphibians using satellite imagery.	**Wegmann, M.***, Rödel, M. O.	Würzburg
12:15-12:30	Energy issues in Nepal himalayas; an overview on its present status, problems and future	**Sah, S. P. ***	Helsinki

Session VIII: Friday 25th February 2005, 14:00-16:00

Parallel session A (HS 10):

Human resource use of tropical ecosystems: patterns, conflicts and conservation issues

Chairperson: Dr. Frank Suhling

14:00-14:15	Diversity patterns of epiphytic lichens and bryophytes along a gradient of human disturbance in montane rain forest in southern Ecuador	**Nöske, N. M.***, Gradstein, S. R., Sipman, H. J. M.	Göttingen, Berlin
14:15-14:30	Climate change and resource allocation in Andean species of *Lepidium* (Brassicaceae): possible effects on species maintenance and migration	**Jácome, J.**, Kessler, M.	Göttingen
14:30-14:45	Dye tracer and column experiments to study dynamics and patterns of preferential flow paths and hydraulic properties of disturbed and undisturbed soils in a tropical mountain rainforest (south Ecuador)	**Bogner, C.***, Engelhardt, S., Huwe, B.	Bayreuth
14:45-15:00	Analysing the edge effect in rain forest using a dung beetle assemblage	**Feer, F.**	Paris
15:00-15:15	Changes in land use patterns on Borneo (Malaysia): Ant communities (Formicidae) in	**Pfeiffer, M**, Teh, C. L., Ho, C.T.	Ulm, Sabah, Banting

	oil palm (*Elaeis guineensis*) plantations - a biodiversity assessment		
15:15-15:30	Evaluation of the potential of biodiversity - conservation on private land in the east of Bolivia	**Choquehuanca, J.**, Gerold, G.	Göttingen
15:30-15:45	Indigenous and scientific knowledge on soil quality indicators in Cabuyal Watershed, Cauca Colombia: a comparative study	**Rivas, A.*** , Gerold, G.	Göttingen
15:45-16:00	Reconciling human resource use and nature conservation in Biosphere Reserves: Insights from Cuban case studies	**Bertzky, M.**, Stoll-Kleemann, S.	Berlin

Parallel session B (HS 7):

Species interactions

Chairperson: Prof. Dr. Siegmar Breckle

14:00-14:15	Factors affecting malaria infection rate in New World primates	**Nunn, C. L.**, Heymann, E. W.	Berkeley, Göttingen
14:15-14:30	Modulation of the corticosterone stress response by reproduction in a frugivorous Neotropical rainforest bat (*Artibeus jamaicensis*) in Panama	**Klose, S. M.** *, Kalko, E. K. V.	Ulm

Parallel session B (HS 7):

Free topics

Chairperson: Prof. Dr. Siegmar Breckle

14:30-14:45	Floral diversity of a sucessional plant community in the Atlantic rainforest region in Pernambuco/Brazil	**Kimmel, T.*** & Gottesberger, G.	Ulm
14:45-15:00	Tree regeneration within natural canopy gaps in a South Ecuadorian montane forest	**Homeier, J.***, Breckle, S. W.	Bielefeld
15:00-15:15	Determinants of small scale diversity of understorey plants and epiphytes: An example from a North-Eastern Amazonian lowland rain forest	**Horchler, P.J.**, Kreft, H.	Koblenz, Bonn
15:15-15:30	Relation between nutrient fluxes and plant species richness in a tropical montane rainforest of Bolivia	**Schawe, M.***, Bach, K., Gradstein, S. R., Gerold, G.	Göttingen, Marburg
15:30-15:45	Inter-annual variations in nutrient dynamics under an Ecuadorian montane forest	**Boy, J.**, Wilcke, W., Goller, R., Fleischbein, K., Valarezo, C., Zech, W.	Berlin, Bayreuth, Giessen, Loja
15:45-16:00	Net primary production, biomass and carbon-stocks in Amazonian white-water forests	**Wittmann, F.***, Schöngart, J., Piedade, M. T. F., Junk, W. J.	Plön

16:00-18:00	**Closing, awarding prizes (HS 10), Coffee (Thaer – Saal)**	**Linsenmair**

Poster presentations (Thu 24.02.2005)

Every presenter has exact one minute to present his / her poster with the possibility of showing one overhead.

1. R.Peveling	Activity of termites and other epigeal and hypogeal invertebrates in natural semi-deciduous forest and plantation forest in Benin
2. J. Beck	The range-abundance relationship in southeast-Asian hawkmoths
3. A. Berger	How to measure changes of daily rhythms in activity and feeding behaviour caused by climate in wild animals?
4. A. Bräuning	Detection of growth rings in tree species of a tropical mountain rainforest in Loja Province, southern Ecuador
5. G. Brehm	Diversity of geometrid moths in two Neotropical montane rain forests
6. S. Engelhardt	Complexity analysis: a new useful tool to characterise hydrological time series in a tropical mountain rainforest and to value different model approaches (south Ecuador)
7. N. Hilt	Change of Ecuadorian arctiid communities with forest succession: Gross taxonomic composition and biotic defense
8. R. Zimmermann	Floristic composition, stand structure and soils of the lower montane forests over tropical karst in the Yuracyacu Valley, Cordillera Oriental, Peru
9. U. Soltau	Is leaf variegation in *Caladium steudneriaefolium* (Araceae) serving as mimicry?
10. M. Schrumpf	Forest soils on the southwestern-slopes of Mount Kilimanjaro
11. S. Markwardt	Validity of pedotransfer functions in two microcatchments of a tropical mountain forest in Southern Ecuador
12. H. Freitag	Determinants of the longitudinal zonation in Decapoda (Crustacea) in rivers of Palawan Island, the Philippines
13. D. Göttlicher	A meta database as basis for modelling water and nutrient fluxes in a tropical mountain forest, south Ecuador
14. Gurlin, D.	Correlation of relief and vegetation in northern Ivory Coast on the basis of a digital elevation model (DEM)

15.V. Horna	Water use and growth response of a strongly seasonal dry forest at the West Andean foothills in North Peru
16. A. Gorrin	Baseline monitoring of forest conservation in the influence zone of a gas pipeline in Bolivia: an approach evaluating anthropogenic forest use
17. D. Mezger	Trophobioses between ants and hemipterans in a tropical rainforest in Borneo
18. N. Mandl	Terrestrial bryophyte diversity in montane ridge forest of southern Ecuador
19. M. Lehnert	Pteridophytes of the Purdiaea nutans forest in the Reserva Biologica San Francisco, southern Ecuador
20. F. Werner	Diversity of vascular epiphytes on isolated remnant trees in the Andes of southern Ecuador
21. M. Huck	Genetic relationship in groups of a cooperatively breeding primate
22. S. Klose	Reproductive modulation of stress sensitivity may impose selective bottleneck on New and Old World tropical Chiroptera in times of climate change
23. S. E. Spehn	The use of sensory cues for foraging by two sympatric Neotropical gleaning bats
24. M. Pfeiffer	Vanishing wildlife and the dilemma of conservation: The continuous dependence of rural villagers on bush meat in Sabah (Malaysia) on Borneo
25. M. S. Ulbricht	Seed production, germination, and seedling growth of *Parkia pendula* (Willd.) Benth. ex Walp. (Mimosaceae) in a Mata Atlântica fragment in Pernambuco, Brazil: Differences between edge zone and forest interior
26. K. Riede	Repatriation of knowledge about insect type specimens through the DORSA Virtual Museum (Digital Orthoptera Specimen Access)
27. N. Köster	Are Amazonian rainforests really poor in epiphytes? - It's just a question of scale
28. H. Kreft	Geographic range size and the explanation of spatial diversity patterns of New World palms
29. K.-H. Lampe	An interdisciplinary Workshop on biodiversity: systematics, statistics, informatics, GIS & applied field methods
30. B. Leischner	Propagation of native tree species of the tropical mountainous rain forest in South Ecuador

31. P. Löttker	Reproductive seasonality in relation to climate and fruit availability in wild moustached Tamarins (*Saguinus mystax, Callitrichidae*, Primates)
32. D. Miah	Forest biodiversity conservation by the Mro tribe in Chittagong Hill Tracts in Bangladesh: The present national policy and practice
33. S. Mester	Population dynamics of two sympatric mouse lemurs (*Microcebus murinus* and *M. ravelobensis*) in north western Madagascar
34. S. Meusel	Dynamics of soil respiration along an elevation gradient in a montane tropical undisturbed forest in southern Ecuador
35. U. Moldrzyk	Food and time - niche ecology of a sand dune reptile community
36. H. Oberender	Population structure and intraspecific agonism in the fungus-growing termite *Macrotermes bellicosus* (Isoptera, Macrotermitinae)
37. N. Rueger	Modeling the regeneration of disturbed tropical montane cloud forest in Central Veracruz, Mexico
38. P. Wester	Bird pollination in South African *Salvia* species
39.K. Zippel	Adaptation to climate in enset landraces: changes in the leaf anatomy

Abstracts of Plenaries

Ecological Studies in the Tropics – past and future

Prof. a.D. Dr. Siegmar-W. Breckle / Bielefeld

This lecture will give an overall view on the aspects of ecological research in the tropics. The delimitation of the tropics and the relevant areas which have been and which are subject of studies will be tackled. The lecture will raise several open questions which need answers in the future.

The lecture will present many slides in the background from plants, animals and landscapes from tropical regions and tropical sceneries, but will also discuss examples of former and ongoing German research projects.

Ecological studies in the tropics is a very wide field. It comprises many subjects and disciplines. Tropical regions are three-dimensional as other zonobiomes, too. Thus, the lowland and the mountain tropics, the whole elevational sequence is an important fact with many open ecological but also economical and social questions. In all mountains and especially in the tropics sustained upslope services and downslope safety depend on slope stability which in turn depends on a diverse and intact vegetation cover with associated animal and microbial life. In this respect the GMBA, the Global Mountain Biodiversity Assessment is very active.

There have been good long-term projects. Scientists in Tropical Ecology should be aware that for decades already there have been sophisticated studies in the tropics (there are archives and good documentations). They should avoid to invent the wheel for a seventh time. There was the TÖB-programme by the Ministry of Economical Cooperation (BMZ), it was stopped without good reasons. Future projects should also be planned for decades (trees live longer than a decade). It makes no sense to finance doctoral students only two years (this is lost tax payers money). Future research projects should be maintained in all major tropical regions, including the arid tropics, probably not only by Germany but by a pan-European action plan.

We need more joint projects with tropical countries and institutions. Tropical Ecology needs specialists (in many fields e.g. taxonomy and systematics, as well as in basic ecology to do analysis and synthesis and in many other fields of biology as e.g. mycology, but also in soil science etc.).

But how we can attract students to study tropical biology, if many faculties of German universities (and elsewhere?) drop oganismic biology and become more and more unbalanced. Biology is much more science than investigations dealing with *Drosophila* and *Arabidopsis.* This is even more important regarding tropical biology. Data base systems for systematics and taxonomy with images and identification parameters or keys are urgently needed. Herbaria as documentation centers have to be maintained and enlarged, despite the fact that many biological faculties have forgotten or even deny the worth of herbaria. Many good museums in the Western world do a very good job in documentation and conservation.

Students still need textbooks (the new edition of the totally revised volume 2 of the „Ökologie der Erde" is one reason for this plenary-lecture). Students still should have chances to participate biological excursions, this is always the most efficient way of learning. Is the German situation hopeful or hopeless? The very nice exhibitions which are presented here and there are a good sign. They present food for thoughts. Biology students (in Germany, and in other countries?) need more freedom and own responsibility for their curriculum e.g. in choosing their subjects during studies. Universities and Faculties have to offer more practical courses and excursions (including tropical areas for advanced students). In general, Natural Science should become again a major and not only facultative topic in all schools.

The modern methods, now available, should be used adequately to improve our understanding of the dynamics and processes (regeneration, interactions etc.) in ecosystems

of the tropics. Research in Tropical Ecology should include modern techniques (e.g. remote sensing, modelling, clear management of data bases and documentation). They should be well coordinated and should have long-term goals. They must be cooperative, interdisciplinary and international. Joint efforts are always better. This needs certainly a thorough study on all levels of space and time. Especially the issue of scale is more and more an important question (chloroplasts >leaves >other organs >trees >stands and sites >landscapes >regions >global; terrestrial/limnic/marin; crown and canopy, above and below ground).

The modern methods in molecular biology on the one hand, remote sensing for surveying areas from the space with very high resolutions and with different spectral wave length on the other hand give many new and hitherto unkown opportunities for science. Installation of surveillance systems for science is always good (they could have saved recently the life of many people but not the forests in South-East Asia).

Basic science and applied science have always to work jointly. Tropical Ecology is also a focal point for applied science and possible solutions for many relevant regions. Tropical ecology has a global dimension as all the UN Conventions, especially that on Biodiversity. The evolution of tropical organisms and tropical ecosystems took million of years, the destruction only a few decades of years. Aren't we able to stop it? Are we forced to study more and more the burned and dissected, but still very diverse, mostly secondary forests?

In any case, researchers in the tropics should be aware that they are guests of local people and that they have to respect local traditions and local economy. Improving local situations can only be a joint effort.

Knowledge in Tropical Ecology is a necessary precondition for sustainable agriculture and forestry in the tropics, as well as for the protection and conservation of Nature Reserves, Biosphere Reserves, National Parcs etc. In the past and also in the future studying ecology in the tropics is not only basic science, tropical ecology is a must for mankind.

„Rainforestation Farming"- an innovative application of the ecosystem approach in the Philippines

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The Convention on Biological Diversity adopted the ecosystem approach for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable fashion.

An innovative ecosystem approach, combining the necessities of rural development, biodiversity conservation and rehabilitation and a sound resource management was developed on the island of Leyte in the Philippines. This approach, under the acronym of "Rainforestation Farming" is based on the assumption that a farming system in the humid tropics is increasingly more sustainable the closer it is in its species composition to the original local rainforest (Milan & Margraf, 1994).

This recommended subsistence farming technology includes indigenous forest and fruit trees, as well as shade-demanding crop plants like the fiber-banana, *Musa textilis.*

First year sun-demanding pioneer trees are planted at close distances of 2 x 2 m to reach a closed canopy for shading out grasses, like *Imperata cylindrica.* Second year hard –timber trees and fruit trees are planted in the shade of the pioneers. Seeds and seedlings come from mother trees in the remaining natural forest. Identification, protection and collection of the seeds and seedlings are part of the village-based community activities.

After already 4 years a forest with about 20-25 different rainforest and fruit tree species is usually established in the former *Imperata*-grassland.

The reforested closed canopy area is a newly created habitat even for such endangered species like the insectivorous nocturnal ape *Tarsius syrichta,* the herbivorous flying Lemure, *Gynocephalus volans,* as well as numerous bat species, amphibians and insects.

Key words: Rainforestation, Biodiversity Conservation, Subsistence Improvement, Leyte, Philippines

Savannas and sustainability – Ecological and socio-economic criterions for a sustainable land use

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Savannas are the most common type of vegetation in the tropics and the subtropics. They are home to the great majority of people on the African continent. At the same time, these ecosystems are increasingly endangered by environmentally mal-adapted human land use. A considerable discrepancy exists between the economic significance of savannas and the relative lack of knowledge about savanna ecology. The ecological processes in savannas under human land use are particularly complex.

From an ecological point of view, any form of land use involves certain disturbances. Anthropogenic disturbance regimes differ from natural disturbance regimes in many aspects. The question therefore arises, to what extent an ecologically successful, i.e. sustainable, utilisation of savanna rangeland implies a disturbance regime similar to the natural disturbance regime. Savanna range management should therefore be evaluated on an ecological as well as an economic level: (1) Which grazing system is most successful from an ethno-economic point of view (by minimising risk and by being socially acceptable) and from an ecological point of view (by conserving resources and maintaining productivity)?, and (2) Is ecologically and economically sound range management linked to a disturbance regime similar to the natural disturbance regime?

To deal with these questions, a systematic interdisciplinary study is conducted on four different grazing systems in north-western Namibia. Similar sets of methods are applied to all grazing systems. Permanent monitoring plots have been established along gradients of decreasing land use. Studies of demography, household economy, and of social networks are carried out to analyse the ethno-economic sustainability of these grazing systems. In close co-operation of ethnologists with vegetation ecologists, herders and farmers will be interviewed to evaluate indigenous knowledge of fodder plants and the perception of recent and historical degradation processes. The results of this interdisciplinary project will reveal causal relationships within the grazing systems and thus generate an understanding of processes. This is indispensable for the development of adequate management practices.

Abstracts of Posters and Talks

Exploring the potential use of medicinals aroids as non-timber forest products in Bolivia

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In the Amazonian region, the plant family Araceae is widely used the traditional medicine, mostly for external healing, for example for skin affections, remedies for bites and stings, and wound healing. In the future, aroids as non-timber forest products (NTFPs) will play an important role to generate benefits for the people in rural areas. The aims of this study were: to 1) compile information about medicinal use of aroid species in Bolivia, and 2) perform a rapid evaluation of population vulnerability to recommend the most suitable species for sustainable use. Floristic inventories were carried out in plots of 20 x 20 m in different habitat types at 32 locations to obtain relevant data about species' ecology. Eight medicinal species were registered and the frequency of occurrence and cover were calculated. Distribution maps generated by the computer program BIOM were also analysed. The maximum value of vegetative cover related to the distribution of species in different forest strata was considered for determining the facility of harvest. Regarding ecology and facility of harvest of medicinal species, the most promising species for a wider utilization will be Philodendron camposportoanum and Syngonium podophyllum because of their wide distribution, high frequency in different habitat types, even in secondary vegetation, and relatively high local abundance. Their hemi-epiphytic life form at ground level and in the inferior forest strata favours their harvest. The utilization of these plants can be done in a sustainable way because it is not necessary to harvest the whole plant, only the leaves, stems and latex. However, future research should emphasize studies of the harvesting effects, population density, reproduction rate and stability, in order to validate these suggestions.

Interspecific hybridization in *Caiophora* and *Nasa* (Loasaceae)

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Natural hybridization in *Nasa* and *Caiophora* (Loasaceae) is investigated based on 198 resp. 208 populations in the wild, c. 2000 herbarium collections and greenhouse experiments. 15 interspecific hybrids (c. 1 % of the collections revised) are reported from *Caiophora*, including hybrids between phylogenetically widely distant taxa, and all appear to be fertile. Two interspecific hybrids of *Nasa* are reported (0.23 % of the collections revised, only from our collections), one of which is sterile, the other fertile (0.12 % fertile). Experimental crosses indicate that hybridization barriers are next to non-existent in *Caiophora* (36 of 37 interspecific crossed led to fruit formation), but well-developed in *Nasa* (0 of 16 interspecific and intersubspecific crosses led to fruit formation). All natural interspecific hybrids appear to be the result of habitat disturbance, mostly agriculture, road construction and the introduction of weedy species. However, man-made hybridization does not appear to be a threat to biodiversity, and may rather increase diversity.

The conquest of High Andean habitats by Loasoideae — correlations between nectar production, floral morphology, pollination syndrome and elevation in some Loasoideae (Loasaceae) from South America

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Loasaceae subfam. Loasoideae comprises some 200 species in 14 genera. 20 species from Peru, Chile and Argentina corresponding to 5 genera (*Loasa, Caiophora, Blumenbachia, Nasa, Presliophytum*) have been cultivated in our greenhouses and were used for the present study. Nectar production and nectar concentration, and absolute sugar production for a total of 235 flowers has been investigated. The combination of these data allows to predict pollination syndromes on the basis of pollinator preferences as documented in the literature and pollinator data from the field. The combination of floral morphology and nectar data allows us to group all taxa investigated into four largely homogeneous groups correlating to typical pollination syndromes.

Group 1: Taxa with mostly white, spreading or deflexed petals and multicoloured nectar scales. The flowers produce small amounts (1—4 µl) of highly concentrated nectar (50—70%). Short-tongued bees (typically Colletid bees) appear to be the main pollinators.

Group 2: Taxa with orange or reddish, erect or spreading petals and nectar scales.. Nectar concentration ranges from 40—60% and production from 10—20 µl. Long-tongued bees (Centris- and Bombus bees) and hummingbirds were observed as main pollinators.

Group 3: Most taxa with orange, erect petals and unicoloured, green, orange or white nectar scales. Nectar concentration is between 30—50% whereas nectar production is high (40—90 µl). Hummingbirds seems to be main pollinators.

Group 4: Only two taxa with orange respectively white, erect petals and white nectar scales. Nectar production is high as in group 3, but concentration is very low (8—12%). Rodents appear to be the pollinator (Coccuci & Sersic, 1998, Pl. Syst. Evol. 211: 113—128), but hummingbirds, passerines and bees were also observed.

Highly concentrated nectar (group 3, 30—55%) is apparently correlated with winding/ erect growth habit and low concentration (group 4, 8—12%) with decumbent growth habit.

The four groups are strongly correlated to altitudinal distribution: Group 1 comprises taxa mostly from elevations of 0—1500 m, followed by taxa from group 2 growing at 2000—3000 m. Typical taxa for group 3s and 4 are found at elevations of 3000—4500 m.

Concerted changes in floral morphology and nectar production and concentration appear to have been crucial aspects in the recruitment of pollinators and may have been the basis of the conquest of High Andean habitats by Loasoideae.

The composition of the plant communities of Kakamega Forest, Kenya – A first description and the role of anthropogenic influence

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Kakamega Forest is the easternmost remnant of the guineo-congolian rainforest system in Kenya. 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 collecting of firewood are still present.
In this fragmented forest research on the remaining flora of vascular plants and the anthropogenic influence on it was conducted in the last three years. The composition of species in the forest, its fragments and the protected areas of the Nature and National Reserves of Kenya Wildlife Service and Forest Department were documented and compared to checklists compiled by former studies. A loss of some important tree species like the "African Mahagony" *Entandophragma anolgense* could be demonstrated. A total of about 397 taxa of 93 families were found during this study. Species known so far for Kenya but not for Kakamega Forest are for example the tree species *Suregada procera* or the climber *Dregea abyssinica.* A new very rare *Dorstenia* (Moraceae) and an abundant *Renealmia* species (Zingiberaceae) were found. Calculations of α-diversities of the investigated study sites shows that disturbed parts have higher values than undisturbed. β-indices exhibit a low overlap of species between the study sites, probably due to the different disturbances histories.
Another aspect was the description of plant communities of Kakamega Forest following the criteria of the Braun-Blanquet approach. In 19 study sites all over the forest and in every surrounding fragment 200 relevés were established. Cover of every species in separated vegetation layers was estimated by the Londo scale. 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. An example of indicator species for each succession stage are the group of climbers. Their occurrence and abundance allows predictions about the age and stage of the investigated forest site.
Differences were found between the communities of the north and of the southern fragments which are probably due to the different soils and microclimates. Analyses with data gathered by other BIOTA-East subprojects will be presented and discussed.

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Activity of Termites and other Epigeal and Hypogeal Invertebrates in Natural Semi-deciduous Forest and Plantation Forests in Benin

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Soil invertebrates represent an important base of terrestrial food chains and play an important role in maintaining the soil fertility and productivity of forest ecosystems. We examined the activity of termites and other soil- and litter-dwelling invertebrates in natural semi-deciduous forest, teak plantations of different age and firewood plantations of the Lama forest reserve, Benin, using a cardboard baiting method. The frequency of occurrence of individual invertebrates attracted to the baits was measured from May 2002 to April 2004, covering two rainy and two dry seasons. Twenty-one different invertebrate groups were sampled. The overall frequency of occurrence of invertebrates differed among forest types. It was significantly higher in natural forest (476) than in young teak (377) and old teak plantations (338). No significant differences were found among firewood plantations (412) and the other forest types. Analyses of individual taxa showed that Isopoda, Hymenoptera and Araneae dominated in natural forest, with frequencies of occurrence of 94, 25 and 27, respectively. Collembola dominated in firewood plantations (127), whereas Isopteran and Diplopod were more active in old teak plantations, with frequencies of occurrence of 65 and 49, respectively. Overall, Collembola, Isopoda, Isopteran, Diplopod, Araneae and Hymenoptera (ants) were the most frequent soil invertebrates of Lama forest. Repeated measures analyses showed significant differences in the frequency of occurrence among seasons for all majors invertebrate groups, as well as significant differences among forest types for all these groups except Diplopoda and Araneae. The activity of soil invertebrates was usually lowest during the long dry season. Moreover, termites were more active in old teak plantations (ferralsol soils) than in the other forest types (vertisol soils).

Keywords: Semi-deciduous tropical forest; teak and firewood plantations; termites; soil invertebrates; seasonality; cardboard-baiting.

Termite assemblages in a West-African semi-deciduous forest and teak plantations

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The Lama forest reserve comprises one of the last tracts of natural forest in southern Benin, West Africa. It includes various types of forest subjected to different levels of disturbance, including remnants of natural and degraded semi-deciduous forest as well as teak plantations. We studied effects of the conversion of natural forest into teak plantations on the structure and functional diversity of termite assemblages. Termites were chosen because of their key role in tropical food webs and decomposition processes, and because of their sensitivity to forest disturbances. Four belt transect (2 m x 100 m) surveys were run in each of the two forest types, adopting a standardized termite diversity assessment protocol. Termite assemblages were remarkably species-poor, with only 19 species encountered on the eight transects. The low species rich-ness was related to the black cotton soil (vertisol) which excluded most soil-feeders of the soil/humus interface and all true soil-feeders. This was also re-flected by the complete absence of Apicotermitinae (soil-feeders). Mean species richness was significantly higher in natural forest (9.5 per transect) than in teak plantations (6.5), but mean termite encounters were significantly lower (96 versus 219 in teak plantations), equivalent to 0.43 and 1.09 encounters per square meter, respectively. Termite assemblage and feeding group structure differed significantly among forests. Kalotermitidae (wood-feeders) were only found in semi-deciduous forest. In contrast, Macrotermitinae (fungus-growing wood- and litter-feeders) were more species-rich and about four times more abundant in teak plantations. The feeding group structure was mirrored in significantly different weighted humification scores of the two assemblages (1.914 in natural forest versus 1.996 in teak plantations). Principal components analysis and multiple regression were combined to analyse the relationship between termite assemblages and environmental variables. The analysis identi-fied two significant predictors of termite assemblages, soil water content (higher in natural forest) and leaf-litter biomass (higher in teak plantations). The high encounter density of fungus-growers in teak plantations seems to be related mainly to these factors. Indirect evidence also suggests that a lower predation pressure by ants in teak plantations may have contributed to the high density. Our results indicate that changes in termite assemblages brought about by the conversion of natural forest into teak plantations may eventually translate into changes in soil fertility, with possible consequences for teak productivity.

Are there sharp elevational limits in vegetation composition in species-rich tropical montane cloud forests?

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We studied the vegetation composition of six vascular plant groups (ferns, melastoms, aroids, bromeliads, palms and cacti) in relation to climate and soils along an elevational gradient in a species-rich tropical cloud forest in the eastern Andes of Bolivia, between 1700 to 3400 m.

Our aim was to analyse the elevational limits of vegetation belts and their correlation with abiotic factors. To this purpose, we analysed a large set of vegetation relevees using phytosociological analysis (Tabwin), cluster analysis (Ward), parsimony analysis, ordination (DCA), and a Monte Carlo simulation. Correlations with pedological factors were analysed by ordination, correlation, and regression.

Depending on methodological approach, we detected none, one, or two elevational limits between vegetation units. Using Monte Carlo simulation different limits were detected for each studied plant group. Elevational ranges of terrestrial taxa correlated significantly with exchangeable cations (K, Mg), total N-content and base saturation of the A-horizons ($P<0.05$), as well as with (high) precipitation.

The results allowed for recognition of three vegetation belts, separated by broad transition zones between 1850 - 2150 and 2700 - 3100 m a.s.l. Sharp elevational limits between vegetation belts could not be detected.

The range-abundance relationship in southeast-Asian hawkmoths

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A positive relationship between the local abundance and the geographical distribution of species is one of the most commonly reported patterns in 'macroecology' (e.g. Gaston et al. 2000, Maurer 1999). However, there is a strong taxonomic and geographical bias in the investigation of this relationship: few, relatively spatially restricted studies have addressed tropical insects. We present an analysis of the range-abundance relationship in hawkmoths (Lepidoptera: Sphingidae) of Southeast-Asia, using comprehensive range areas and abundance measurements of sub-continental extent. Range areas were estimated using a GIS-supported procedure from over 34.500 records for the 380 hawkmoth species that occur between Burma (Myanmar) and the Solomon Islands. The resulting distribution maps can be accessed at *http://www.sphingidae-sea.biozentrum.uni-wuerzburg.de*. Local abundances were measured by light trapping, using a compilation of data from our own sampling, supplemented by published and unpublished quantitative collections. A significant positive range-abundance relationship was found. The strength of the relationship is apparently influenced by geographical region, habitat disturbance and elevation, but not by body size or subfamily identity within the Sphingidae, which might be connected to differences in life history and dispersal ability.

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How to measure changes of daily rhythms in activity and feeding behaviour caused by climate in wild animals?

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Global warming and its consequences for habitat conditions are recognised as major threats to conservation objectives worldwide. Already the Kruger National Park has experienced precipitous declines in three of its rare antelope species: roan antelope, tsessebe and sable antelope. Whether these declines are due to climatic shift, or local factors such as consequences of excessive provision of water points, is uncertain. However, the fact that population declines are more widespread and involve other species as well suggests that more general factors might be operating, such as the immediate effects of global warming on habitat conditions. It is the question, how animals, in special African ungulate species cope withdifferent temperatures in their behaviour, activity patterns and feeding.

The behaviours activity and grazing were recoded continuously by the storage telemetry system ETHOSYS® (Scheibe et al. 1998). For comparison, in domestic and feral horses as well as in Przewalski-horses in close to natural conditions the effects of high temperature on daily behaviour patterns have been investigated in Germany. Temperatures above 25°C caused a reduction of activity and grazing during daylight and increased nighttime activity. The 24-h level of feeding was reduced but not the total activity time in the same conditions.

Behaviour records by the same telemetry technique were taken on three zebra, on four blesbock and on two wildebeest in Suikerbosrand Nature Reserve. To describe the rhythmic structures regarding stability and frequency coordination, the degrees of functional couplings (DFC) were derived from spectral analysis. The DFCs had already proved as indicators for different kinds of disturbance, disease, and stress in European domestic animals and wildlife as well as for heat stress in domestic cattle in the tropics (Scheibe et al. 1999). In Germany, DFCs were reduced in cold conditions in horses and sheep. The aim ot the investigation is to identify normal daily patterns for the different African species and to find out, how the different parameters of activity rhythm are influenced by high temperatures.

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Bottom-up or top-down: a case study on phasmids (Phasmatodea)

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Herbivory is discussed as a key agent in maintaining dynamics and stability of tropical forested ecosystems. Accordingly increasing attention has been paid to the factors that structure tropical herbivore communities.

In a two-year study I (1) described diversity, density, distribution and host range of the phasmid community (Phasmatodea) of a moist neotropical forest in Panamá, and (2) experimentally assessed bottom-up and top-down factors that may regulate populations of the phasmid *Metriophasma diocles*.

The species poor phasmid community of Barro Colorado Island was low in density. Phasmids mainly occurred along forest edges and restricted host ranges of phasmid species reflected the successional status of their host plants. Only *M. diocles* that fed on early and late successional plants occurred regularly in the forest understory.

A long generation time with a comparably low fecundity converted into a low biotic potential of *M. diocles*. However, modeled potential population density increased exponentially and exceeded the realized densities of this species already after one generation indicating that control factors continuously affect *M. diocles* natural populations. Egg hatching failure decreased potential population growth by 10 % but was of no marked effect at larger temporal scale.

Interspecific differences in defensive physical and chemical leaf traits of *M. diocles* host plants, amongst them leaf toughness the supposedly most effective anti-herbivore defense, seemed not to affect adult female preference and nymph performance. Yet, a significant rejection of leaf tissue with artificially increased natural phenol contents by nymphs indicated a qualitative defensive pathway in *Piper* host plant evolution. I suggest that differential performance of nymphs may crucially affect their recruitment into the reproductive adult phase.

Neonate *M. diocles* nymphs suffered strong predation pressure when exposed to natural levels of predation. Concluding from significantly increased predation-related mortality at night, I argue that arthropods may be the main predators of this nocturnal herbivore. Migratory behavior of nymphs seemed not to reflect predation avoidance. Instead, I provided first evidence that host plant quality may trigger off-plant migration.

In conclusion, I suggest that predation pressure with its direct effects on nymph survival may be a stronger factor regulating *M. diocles* populations, compared to direct and indirect effects of host plant quality, particularly because slow growth and off-host migration both may feed back into an increase of predation related mortality.

→ Referenzen
Phasmidae i. primären Arbeiten

Ecotypic differentiation versus phenotypic plasticity – variation in the eurytopic Amazonian millipede *Poratia obliterata* (Diplopoda: Pyrgodesmidae)

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The Neotropical millipede *Poratia obliterata* (Kraus, 1960) is most likely to have evolved in Andean foreland forests and has successfully colonized various habitats throughout Amazonia (Peru, Colombia, Brazil), Costa Rica and Panama.

In the Brazilian region of Amazonia, this small species inhabits non-flooded upland plantations (banana: *Musa spec.*; palm tree: *Bactris gasipaes*, *Elaeis guineensis*) and upland forests as well as three types of inundation forests (white, black, mixed water). Here, the terricolous *P. obliterata* developed survival strategies adaptive to periodically flooded habitats. Observations in the field indicate that populations from plantation and inundation forest sites differ in respect to their behavioural traits. The animals in inundation forests escape flooding by climbing tree trunks. They pass the aquatic phase in aggregations close to the water line, thereby avoiding dehydration, and temporarily cease to reproduce. In contrast, animals on plantation sites dwell in moist decaying plant material without aggregation and reproduce continuously. Therefore, 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 ecotypes. However, analyses of allozyme variation (six enzyme loci: PGI, PGM, GOT, ME, PK, ACP) indicate low genotypic differentiation between populations from upland plantations and those from inundation forests. Hence, the alternative life strategy of populations in floodplain areas seems to be a phenotypic response to environmental constrains, indicating profound plasticity in this species. Populations of different inundation forests are genetically similar, presumably originating from the same ancestral upstream population near to Iquitos, Peru. Genetic distances between these populations were not correlated with geographic distance and isolation, respectively. We conclude that permanent downstream dispersal of individuals along the rivers maintains high gene flow between the consequently genetically homogenous populations.

Towards a Catalogue of the Plants of Colombia

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Colombia, with an estimated 30.000 species of plants is the second richest country on Earth in terms of its plant diversity. This cooperative Colombian-German project, partially supported by the Volkwagenstiftung, aims at analysing the total plant diversity of Colombia, through a compilation of a Catalogue of the Plants of Colombia. Accumulated information of previous research by Colombian, European, North American and Latin American botanists now allows for the scientific assessment and compilation of such a Catalogue. The Catalogue is a highly needed instrument for botanical and ecological research, conservation and sustainable use of plants in Colombia, and for capacity building. The work provides a listing of all the species of vascular plants, bryophytes and lichens occurring in the country, with information on their habitat, geographical distribution and conservation status. Vascular plant diversity data of Colombia is being synthesised at the National Herbarium of Colombia, in Bogotá; cryptogamic diversity at the Herbarium of the University of Göttingen, in collaboration with Colombian specialists. Help of numerous specialists in Colombian and in many other countries will be the base for data compilation. A first draft of the Catalogue is scheduled to be ready by the end of 2005. This draft will be the basis whereupon specialists will produce their individual family treatments. Along with the production of the Catalogue, and as a strong input for it, the National Colombian Herbarium is being digitised and digital imaged. Digitised information will be released at the Herbarium's website and through the GBIF and the SIB (Colombian Biodiversity Information Facility) networks.

Reconciling human resource use and nature conservation in Biosphere Reserves: Insights from Cuban case studies

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This paper presents insights about the factors influencing the successful implementation of the Biosphere Reserve concept, based on case studies from Cuba.

Many times, conservation of biodiversity and resource use are contradictory to a certain extent. Nevertheless, the Biosphere Reserve (BR) concept explicitly aims to reconcile both. By distinguishing three zones with different functions, human necessities as well as conservation issues are taken into account, and sustainable levels of resource use are being explored. Globally, more than 440 BRs have been recognised under the UNESCO *Man and Biosphere* (MAB) programme. However, due to the socio-ecological complexity involved, which translates into ambitious requirements of inter-institutional co-operation, it is often unsure whether BRs do in practice fulfil their objectives. The case sensitive identification of success and failure factors for effectively implementing the BR concept therefore constitutes an important challenge and research need. An interdisciplinary group of scientists at the Humboldt University of Berlin, Germany, embarked on a five year project addressing this research need: *GoBi – Assessing Biodiversity Governance and Management Approaches, the Case of Biosphere Reserves.*

Results from the first case studies in two BRs from Cuba do significantly prove the importance of integrating biological with social sciences. An adequate conservation management may i.e. help to defend invasive species but without resource use alternatives, biodiversity may still be threatened by exploitation. In the same way many root causes for biodiversity threats and resource use problems can be identified looking at social backgrounds and political circumstances. Aspects of communication between involved institutions, the degree of environmental education and participation of every group of stakeholders do among many others shape sustainable conservation and resource use. In the end, the success will also largely depend on climate change impacts, no matter how well social and political conditions are, and again justifying the need to integrate several scientific disciplines.

Apart from a description of first results, an overview will be given on the methodologies the *GoBi* project applies for collecting and processing different types of data. GoBi aims to connect the data by means of an integrative model to be used as a decision support tool in biodiversity conservation, sustainable resource use and development within Biosphere Reserves world wide.

Herbivory by stick insects in a tropical rainforest in Borneo – specialists vs. generalists

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Stick insects (Phasmida) are important herbivores in tropical ecosystems, but have been poorly investigated in their natural environment. We studied phasmids and their food plants in a tropical lowland rainforest in Borneo (Danum Valley, Sabah) for the first time. Nineteen species of phasmids were collected from 35 plant species during nocturnal surveys in the forest understorey. In most cases (28 plant species), experiments confirmed that these phasmids feed on those plants from which they were collected. Partitioning of phasmid species among food plant species was significant. Two common species had a largely restricted diet: *Asceles margaritatus* occurred mainly on *Mallotus* spp. (Euphorbiaceae) and *Dinophasma ruficornis* on *Leea indica* (Leeaceae). Other phasmids fed on a broad spectrum of plant families and can be considered polyphagous (e.g., *Haaniella echinata*, *Lonchodes hosei*). Both no-choice and dual-choice feeding experiments were performed on captive phasmids using leaves from eight plant species. *A. margaritatus* showed a significantly higher consumption rate for *Mallotus miquelianus* leaves than for other plants, while *H. echinata* showed the opposite trend and the lowest consumption for *M. miquelianus*. Moreover, the more specialized *A. margaritatus* significantly preferred young leaves of *Mallotus* species, while the polyphagous species *H. echinata* and *L. hosei* significantly preferred older foliage from the same plants. Both the phasmid's distribution in the natural forest vegetation and their selectivity in feeding experiments among plant species and leaf ages reflect large interspecific variation in host specialisation. Such specialisation may not be evident from the phasmid's sheer acceptance of leaves in captivity: oligophagous *A. margaritatus* fed on foliage from several plant families, particularly when *Mallotus* is not offered at the same time. Therefore, studies on specialisation by these herbivores need to focus on their natural tropical vegetation.

Dye tracer and column experiments to study dynamics and patterns of preferential flow pathes and hydraulic properties of disturbed and undisturbed soils in a tropical mountain rainforest (Southecuador).

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The tropical mountain rainforest of the Estación Cientifica San Francisco in the southecuadorian Andes is characterised by a heterogenious geology and natural landslides. These boundary conditions in combination with different landuses cause very heterogenious soils in a small scale area.

The different hydraulic properties and preferential flow pathes are an important aspect to understand the water and substance fluxes of this ecosystem and establish a sustainable landuse. Furthermore these parameters are the basic knowledge for simulatons with hydrological models.

Dye tracer experiments with Brilliant Blue are made on young landslides, old landslides, in primary forests and pastures. An area of 2m² was irrigated with Brilliant Blue and after one day 5 profiles of 1m depth are digged and pictures taken from the profiles. The blue color indicates the flow pathes and with the program SOPHY (from Dr. M. Schlather, University of Luxemburg) the profile pictures are evaluated automatically to detect the flow pathes and calculate the geostatistical parameters of each site. Following with these parameters a 3 dimensional model of the studysite is created.

In addition to the field experiments basic hydaulic parameters are taken at two samples on each site from column experiments in the laborotory.

The results show characteristic differences between each plot. The soil under primary forest with the longest undisturbed soilgenesis has the most regular pattern of fluxes. Soils of young landslides seems to have less structure in the poresystem because macropores are destroyed and in old landslides a reconstruction of the pore networking can be observed. The upper horizon on the pasture shows a clear soil compaction which inhibits the water infiltration strongly. This are the bad consequences of wrong landuse.

Inter-annual variations in nutrient dynamics under an Ecuadorian montane forest

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We studied water and Ca & Mg dynamics in an Ecuadorian lower montane forest during a 5 year period (05/1998- 04/2003) in a small microcatchment in order to obtain a canopy and net budget for those elements to estimate the influence of athmospheric deposition and weathering on the nutrient supply of this forest stand. Water samples of rainfall, throughfall and surface runoff were collected weekly to determine the fluxes of Ca and Mg. Annual rainfall deposition rates of Ca and Mg varied by a factor of five between the observed years (Ca: 2.55-14.81 kg ha^{-1} yr^{-1}; Mg: 0.93-6.54 kg ha^{-1} yr^{-1}, highest input in hydrological year 1999/2000, lowest in 2002/03). During high input periods Ca and Mg were retained in the canopy and the whole system, during low input periods they were leached from the canopy and lost with surface discharge. We assume that the simultaneous input of growth-limiting Mn increased the demand for base metals resulting in canopy uptake of those elements. Weathering did not play a mayor role for nutrient supply during the observed period. We conclude that sporadically occurring high nutrient input years significantly contribute to overcoming nutrient limitations.

Competing dragonfly species in a changing landscape

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In Namibia water is one of the most limiting factors for humans as well as for animals and plants. Within the scope of a BIOTA South Africa subproject a study dealing with the biodiversity of dragonflies was carried out. The aquatic habitats for dragonflies in western Namibia are mostly of an ephemeral character, leading to inter- and intraspecific competition being one important factor for the structure of dragonfly communities in these habitats.

A mathematical model for three different behavioural types of dragonflies has been developed on the basis of extended Leslie matrices. One type represents obligate migrants with little or no habitat preferences, a short larval development and relative high dispersal ability. The two other types represent facultative migrants or residents with certain habitat preferences, a longer larval development and lower dispersal abilities.

The main population dynamic regulating parameter in this model is the development rate of the larvae which is formulated in dependence of the available food and the density of other dragonfly larvae in the aquatic habitat competing for the same food resources. This population dynamic model has been implemented into a cellular automaton model describing the dynamic change of the biomes "tree and shrub savannah", "Nama karoo" and "Namib desert" with regard to the presence of open water in the landscape. Data was acquired using satellite images and expert knowledge, the dynamic change of temporary habitats was derived from precipitation data. This landscape model allows the modelling of scenarios under current and future climatic conditions as prognosed by the IPCC as well as theoretical scenarios investigating the importance of stepping-stone habitats or the duration of the ephemeral habitats.

The model shows that in a community with species with similar life-cycle characterics but different habitat preferences and dispersal abilities the species which is more mobile has a significant advantage compared to the species with lower dispersal. This effect is strongly emphasized in the regions with few permanent habitats and a high variability of the ephemeral habitats due to the climatic boundary conditions. In a community containing the migrant species and one of the residential species, the residential species can establish local populations with higher densities in the permanent habitats in spite of the lower dispersal abilities and the longer development time of the larvae.

Detection of growth rings in tree species of a tropical mountain rainforest in Loja Province, Southern Ecuador

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During recent years, anatomical growth zones were discovered in many tree species in tropical humid climates. However, the seasonality of the anatomical growth zones and the climatological and ecological factors triggering the formation of different anatomical tissues in the wood are often not easy to detect. We applied a sampling technique that allowed the collection of newly formed wood tissues in regular time intervals: small wood cylinders including the active cambial zone were taken every two weeks. In parallel, meteorological and dendrometric data were collected to assign the detected seasonal changes in the formation of anatomical wood tissues to certain climatic factors. The forest site is located in an altitude of 2100 m a.s.l. on the western slope of the Podocarpus National Park in Loja Province, Southern Ecuador. One conifer (*Prumnopitys montana*) and two broadleaved species (*Alnus acuminata, Cedrela sp.*) were selected to construct series of microsections in which seasonal changes in wood anatomy can be distinguished. These studies lay the wood biological basis for further applications in ongoing dendroclimatological and forest growth studies.

What determines instar number in the grasshopper *Cornops aquaticum*, and the implications for its use as a biological control agent

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The tropical grasshopper, *C. aquaticum* is host specific to *Eichhornia* spp., with its occurrence on sexually reproducing *E. azurea* in the southern part of South America, and on mainly asexually reproducing *E. crassipes* in the northern part. In addition, it's present day distribution spans from Mexico to Argentina and so includes a broad range of climatic variables. Recent life-history data on *C. aquaticum* has reported a possible adaptation to one of these variables (flood pulse) with five nymphal instars occurring on *E. crassipes* during rising waters and six during falling waters. This leads us to three possible hypotheses:

(1) *C. aquaticum* evolved on *E. crassipes* in Amazonia, spread north- and southwards, and secondarily adapted to the related *E. azurea*. Instar number represents an adaptation that is genetically fixed with population dynamics being influenced by environmental factors.

(2) *C. aquaticum* evolved independently on *E. crassipes* in northern part of South America and on *E. azurea* in the south. Instar number represents an adaptation that is genetically fixed with population dynamics being correlated with the propagative type of its host plant.

(3) *C. aquaticum* shows a phenotypic plasticity of a single genotype. The various instars represent a response to different abiotic conditions in the respective environments.

And why is this information important?

Although native to South America recent *Eichhornia* introductions throughout the world have caused problems, and to counteract this *C. aquaticum* is being proposed as a bio-control agent. Host specificity has been reaffirmed in native populations, but oviposition and feeding occurred on *Cana indica* in South African tests. Reconfirmation of host specificity and strength is urgently needed prior to a release in South Africa.

Through the use of molecular markers, our study will test for correlations in genetic diversity host, climate and environment, so helping to elucidate what hypothesis is most likely. Here we present initial data on several South American populations, and suggest possible implications this may have on a release.

Diversity of geometrid moths in two Neotropical montane rain forests

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The diversity of geometrid moths (Lepidoptera: Geometridae) was investigated in two tropical montane forests in southern Ecuador and in central Costa Rica. The study covered an elevational range from ca. 1000 to 2700m a.s.l. in both locations. Data was analysed from eight sites, each at four elevational levels. 770 species (4569 specimens) were sampled in Ecuador, and 503 in Costa Rica (7303 specimens). Sampling was incomplete and it is expected that more species will be found in both areas. Diversity was extremely high in Ecuador; at almost every site it was higher than at the sites in Costa Rica. Values of Fisher's alpha ranged between 70 and 131 in Ecuador, and between 31 and 83 in Costa Rica. The analysis of rarefied species numbers led to very similar results. At a level of 390 specimens, the range was 131-179 species at the Ecuadorian sites, and 77-140 species in Costa Rica. Only 64 of 1208 (5 %) of all species were common to the two areas. This study underlines the fact that the tropical Andes are the unrivalled worldwide 'hottest hotspot' of local diversity of geometrid moths, and that the threatened Andean cloud forests should be given the highest priority in conservation policy. Countries such as Costa Rica which are engaged in nature conservation should also be encouraged to continue their efforts since its moth fauna is highly diverse and unique.

Ecology and conservation of hemiparasitic *Krameria lappacea*

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Hemiparasitic *Krameria lappacea* (Dombey) Burdet & Simpson is a shrub up to 1 m tall of semi-arid and arid habitats in S Ecuador, Peru, Bolivia, N Chile and N Argentina. The plant has dark red, strongly zygomorphic flowers and striking spinose, burr-like fruits. Extracts of the roots are used for cosmetical and medicinal purposes and as a dye, and Peru alone exports 100 metric tons of *K. lappacea* roots per year, all of which is collected from wild populations of the plant. However, very little is known about the biology of the plant. Recent studies in the field indicate that *K. lappacea* is a very slow-growing hemiparasitic plant and current use is likely to overexploit its natural populations.

Aim of the present study was establishing biological data allowing for either a more rational and sustainable harvest of *Krameria* from the wild, or the establishment of plantations for commercial use. Field studies were carried out mostly in southern Peru (Depto Arequipa, Prov. Arequipa), plants were excavated and their roots traced to the roots of host plants, to investigate their host specificity. Anatomy of the lateral roots and the haustoria was investigated by microtome sections and SEM.

The roots of *K. lappacea* are weakly branched, very flexible, dark-red and have a smooth and soft bark. Some lateral roots terminate in spindle-shaped root tubers, with unknown function, others form secondary haustoria. The primary root decays beyond the attachment of the lateral roots, after the formation of haustoria on host roots (by the lateral roots). Thus, the mature root system of *Krameria lappacea* consists of a relatively short, straight tap root with laterals radiating from it. These lateral roots horizontally extend for up to 4 m. There seems to be very little host specificity. We directly documented haustoria on plants from families such as Asteraceae, Malvaceae, Portulacaceae, Cactaceae, Fabaceae, Heliotropiaceae, Polemoniaceae and Geraniaceae. The haustorium consists of the "haustorium body" and the "parent root". The haustorium body is composed of a well developed periderm, a cortex, a central region consisting of xylem cells (the "vascular core"), a parenchymatic region (the "central parenchymatous core") and the part of the haustorium embedded in the host tissue (the "endophyte"). The overall morphology and anatomy of both the roots and the haustoria thus correspond to what has been reported for *Krameria lanceolata* by Musselmann (Musselmann, Phytomorphology:416—422. Dec 1975). Additional studies carried out in the field provided rough data allowing first estimates on the sustainable level of harvest in given populations.

The confirmation of the parasitic nature of *K. lappacea*, the recognition of a wide range of its host plants, and first data on its abundance and recruitment in natural populations provide a basis for a sensible, sustainable management of the harvest of this plant in the future.

Evaluation of the potential of biodiversity-conservation on private land in the East of Bolivia

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The main objective of this study was to evaluate the advantages and constrains of the development of biodiversity conservation on private lands in an important area for the connectivity of the Chiquitano forest, an ecosystem, which exists only in the tropical lowlands of Bolivia.

About 20% of the studied area needs to be protected in order to maintain the connectivity between Chiquitano Forest and Amazon Forest. This surface is mainly in hand of private landowners, who usually carry out cattle production.

The case study of landowners, whose holdings are located in the area with priority of conservation, suggests that the proprietors' predisposition to protect wildlife on their land is limited but it does not seem to be impossible to reach. On the one hand, a little but significant number of the studied owners has had interest to establish private reserves, but most of them were discouraged due to the legal requirements (in particular land tittles) and bureaucratic procedures. On the other hand, it was observed that the greater number of landowners prefer to use their land for production purposes and would demand extra benefit if they accept to set aside areas for biodiversity.

This experience shows two major constrains for private participation in biodiversity conservation: the unsolved land property situation and the lack of effective incentives to promote conservation. Both problems will be solved only with the agreement between government and civil society because police changes and inter-institutional measures are needed.

Meanwhile, land use plans, carried out in an ecological perspective that integrate conservation in farming production systems, are a real alternative of private land conservation, for instance, measures such as the introduction of limited/controlled forest production, the establishment of forest reserve areas, wind belts and protected forest river margins would contribute to the mentioned conservation issue.

The traditional form to implement biodiversity conservation on private (that is to set aside lands for wildlife) does not appear to be enough to ensure the protection of ecosystems and the connectivity in the study zone. Then it should be considered as complementary measure in a major conservation strategy.

Impacts of land use strategies on species diversity and herbaceous biomass in the functional land use units of the Borana pastoral ecosystem, Ethiopia

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A survey of species diversity (alpha, beta & gamma) and herbaceous biomass across the different functional land use units called *Kalo*, *Worra* & *Foora* was under taken in the Borana lowlands of southern Oromia to investigate the impacts of land use strategies. Samples for the assessment of species diversity were collected from a total of 109 plots of 400m ^{2} size, whereas, those for her herbaceous biomass were collected from 460 plots of 0.25 m^2. Results showed that relatively protected land use units had the highest species diversity. Total species richness varied from 81 in *Foora* to 117 Dida Hara *Kalo*, demonstrating that high intensity of rangeland unitizations had a negative impact on plant biodiversity. Furthermore, herbaceous biomass varied from 876 kg/ha in *Foora* to 1,406 kg/ha in Dida Hara *Kalo*, again indicating that grazing lands under high pressure had less herbage on offer. It was concluded that high population density of livestock and current inappropriate rangeland management had negatively affected plant genetic resources in the Borana lowlands.

Keywords: Plant biodiversity, land use units, Borana pastoral system

Roost ecology and mating system of the White-throated round-eared bat *Lophostoma silvicolum*

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A species' mating system is often closely connected with the amount of investment by mating partners into courtship and/or parental care. One form of such investment is the making of shelters, crucial for the reproduction and survival of many animals. In bats, the vast majority of species strongly depends on, but does not make, shelters. The Neotropical Lophostoma silvicolum creates and inhabits cavities in active arboreal nests of the termite Nasutitermes corniger. The cost of excavating the hard material of the nests is probably high. This implies that these roosts must offer advantages compared to others such as tree holes, commonly used by other bats. Temperature measurements in cavities of active and dead (=inactive) termite nests and in tree holes occupied by closely related species showed, that the temperature in the active termite nests was extremely stable and 2.1 - 2.8°C warmer than in the other two types. In order to tie these findings to the mating strategy of L. silvicolum, we also investigated this species' mating system. We found a resource-defense polygyny, where single males excavate the nests. However, only nest-males in good physical condition attract females, thereby achieving a high reproductive success (46%). The nests may serve as a cue for females, helping them to choose high-quality males. We propose that the preference of females for males providing roosts with a beneficial microclimate may explain why the making of these unusual roosts has developed in this genus of bats.

Mixed foraging strategies of stingless bees in Borneo

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Stingless bees are among the most important pollinators in the tropics. Their main resources are nectar and pollen. We investigated foraging strategies of six stingless bee species of the genus *Trigona* (Hymenoptera: Apidae: Meliponinae) in a lowland rainforest in Borneo (Danum Valley, Sabah). Bees were captured at nests (*T. collina*, *T. melanocephala*, *T. laeviceps*) or while foraging at flowers from native or exotic plant species (*T. itama*, *T. haematoptera*, *T. collina*, *T. binghami*, *T. laeviceps*). We examined whether individual worker bees collected nectar or pollen or both within the same foraging trip. To study nectar harvest, nectar was extracted from the crop by gently squeezing the bees dorsoventrally and sampled with microcapillary tubes; sugar concentration was determined with a hand-held refractometer.

A large proportion of individual bees showed mixed foraging strategies: between 21% and 67% of individual bees captured at flowers from four plant species had both pollen packages as well as nectar loads, only one species showed almost no nectar loads. Volume and sugar concentrations of nectar loads did not differ significantly between individuals with and without additional pollen loads. In contrast, bees captured at nest entrances had either pollen or nectar loads, the proportion of mixed foraging strategies was only 0% - 12%.

Several earlier studies of bees returning to their nests assumed that individual bees commonly specialise on either nectar or pollen during a single foraging trip. However, the discrepancy between different *Trigona* species, different studies, and between the bees sampled at flowers vs. nest entrances suggests that the expression of mixed foraging strategies may depend on bee and flower species. Our finding suggests that stingless bees efficiently exploit flowers that offer both attractive nectar and pollen. We hypothesize that additional costs in time and energy caused by collecting both resources within the same foraging trip are smaller than those of two separate trips.

Crucial "Ecosystem Services" delivered by flying foxes (Pteropodidae): Seed dispersal in fragmented landscapes in West Africa

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In West Africa many plant species that are of considerable economic value for food and medicinal purposes, especially in rural areas, are dispersed by flying foxes (Pteropodidae). Flying foxes are capable of delivering high quality seed dispersal indispensable for successful recruitment and regeneration of such plants. However, long-term survival of species-rich and abundant flying fox populations is threatened by the ever mounting level of habitat degradation due to different land use practices in West Africa.

We present data supporting the important role of flying foxes as seed dispersers for an ecologically and economically important tree species, *Cola cordifolia* (Sterculiaceae). *Cola* is mainly found in dominant stands in forest islands that represent naturally occurring forest fragments embedded in a savannah matrix.

Flying foxes enable *Cola* seeds and seedlings to escape density- and distance-dependent mortality beneath crowns of parent trees. Simultaneously, seed rain generated by flying foxes is widespread over forest islands and scattered in a random fashion thus increasing the probability of reaching favourable but often random and unpredictable recruitment sites. This dispersal pattern is crucial for the maintenance of plant diversity especially in landscapes prone to frequent change.

Moreover, flying foxes persist on a diverse diet of fruits of different woody plant species including those regarded as keystone species such as figs. Together with our data on high quality seed dispersal this emphasises the potential that flying foxes hold in ensuring the maintenance of a number of key plant species that are of considerable ecological and socioeconomic importance. We point out that this is especially important in subsistence systems where harvests are derived from naturally occurring plant populations where no effective cultivation has been developed.

Further, we believe that flying foxes may hold the potential to substitute at least in part some ecosystem functions of large frugivores that are in serious decline in many areas in West Africa. This further adds to their importance and we suggest ways of ensuring the continued deliverance of such ecosystem services.

Finally, we discuss the relevance of our results in degraded areas in West Africa especially where even the remaining forest fragments are now in danger of being lost to drastic changes in land use practises.

Spatio-temporal dynamics in forest regeneration due to interspecific long-term latrine use by viverrids and herpestids

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African civet as well as sympatric genets and mongooses all use to defecate at regularly visited latrine sites – to which they disperse plant diaspores including such of prominent forest trees.

Latrine and dung observations at coastal Kenya showed that (1) a high density of latrine sites exists and certain sites are (2) used by more than one animal species. These new findings of interspecific latrine utilisation have been confirmed by camera trapping. Furthermore, after an observation break of several years, the investigations showed that (3) numerous latrine sites have been in permanent use for years whereas (4) some have stopped existing and (5) others had moved for some meters or were (6) started as a new site in some distance. In addition, in 1997/98 several months of extraordinary intensive and almost permanent rainfall occurred and its flood-like impact had the power to wash away old and fresh defecations, i.e. entire visible latrines. The findings after such an extraordinary situation explain the stability of the sites and they give an inkling of the autecological orientation and synecological communication..
The observed intra- and interspecific latrine use is probably part of an olfactoric communication system with consequences for natural forest regeneration. Latrines were found along roads, resembling disturbed sites that require diaspores for new plant regeneration. Most of the involved viverrids and herpestids include fruit in their daily diet and disperse plant diaspores. Thus, particularly latrine sharing by several species and/or individuals results in a synergetic accumulation of locally deposited plant diaspores. Diaspore deposition at latrines can cause a relatively spotted initiation of forest regeneration. In observable time dimensions, shared latrine use and its variation combined with secondary seed dispersal can result in plant regeneration over wide areas too. An impact on natural forest regeneration appears considerable, since germinating seeds, seedlings and even some saplings actually have been observed at such shared latrine sites – and this although mortality in plant offspring is generally high.

In conclusion, the observed variation in diversity, space and time at shared latrine sites allows an improved understanding of the complex spatio-temporal dynamics in natural plant regeneration in Africa.

Complexity analysis: a new usefull tool to characterise hydrological time series in a tropical mountain rainforest and to value different model approaches (Southecuador).

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The time series of the different compartments of the watercycle in an ecosystem have a special inner information structure. The very sensitive complexity and information measures characterise and distinguish the particular structure of the time series of precipitation, canopy throughfall, soilmoisture, xylemflux and runoff. The complexity therefor the inner structure of these time series reaches his maximum for half daily or daily aggregated datas. This shows an astonishing relation to the change of day and night.

Furthermore these measures show a particular propagation of the information structure in the hydrological time series while the water passes through the ecosystem. The signal of precipitation and throughfall is a highly randomly signal with only a few structure. The signals of the soilmoisture becomes the more structure the deeper we take the datas. The time series of xylemflux and runoff shows also a high structure of their information content.

This means the soil and the vegetation are able to transform the properties of the information content they have the amazing capability to build up more structure in the time series of the watercycle while passing the ecosystem.

This property of complexity and information measures can be used to value different model approaches to simulate the parts of the watercycle. For this the time series which are generated by models are analysed in the same way with complexity and information measures as the natural time series. The more a model is able to copy the structure and keyprocesses of the nature the more should be this measures similiar.

Complexity analysis is a usefull and powerfull tool to characterise the information properties of parameteres in ecosystems and to value the capability of models to consider the keyprocesses of natural processes.

Enhanced seed dispersal of *Prunus africana* in fragmented and disturbed forests

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Forest destruction and disturbance can have long-term consequences for biodiversity and ecosystem processes such as seed dispersal. Understanding these consequences is a crucial component of conserving vulnerable ecosystems. In the heavily fragmented and disturbed Kakamega Forest, western Kenya, we studied the seed dispersal of *Prunus africana*. In main forest, forest fragments, and differently disturbed sites we quantified the overall frugivore community. Furthermore, we determined the frugivores on 28 fruiting *P. africana* trees, estimated seed dispersal, crop size and the general fruit availability of surrounding trees. During the overall frugivore census we recorded 49 frugivorous species. 36 of them were observed visiting *P. africana* trees and feeding on their fruits. Although the overall frugivore species richness was 1.1 times lower in fragments than in main forest sites, *P. africana* experienced 4.0 times higher numbers of frugivores in fragments than in main forest sites and 6.7 times higher numbers of frugivores in highly disturbed than in less disturbed sites. Correspondingly, seed dispersal was 6.9 times higher in fragments than in main forest sites and 3.9 times higher in more disturbed than less disturbed sites. Fruit availability of surrounding trees and crop size did not influence the number of visitors. Considering the whole life cycle of the tree, the link of primary seed dispersal seems to be strengthened in fragmented and highly disturbed sites. This indicates that ecosystems might contain processes that balance or even counteract the negative effects of human disturbance at least for some time.

Analysing the edge effect in rain forest using a dung beetle assemblage

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Forest fragmentation in tropical areas entails biodiversity loss in plant and animal communities through decreasing area and increasing isolation of fragments. Moreover nature of habitat matrix and changes near fragment edges are known to have a significant impact. It was necessary to study the edge effect independently because it is currently correlated with the effect of variations of fragment area. I examined how dung beetles (Scarabaeinae) – proposed as indicator taxa – distributed across a tropical evergreen forest – savanna ecotone in the Paracou site in French Guiana. Sixty three dung beetles species were captured using pitfall traps and flight interception traps at different distances (up to 240 m) from the forest edge, in savanna and in deep forest. Strong edge effect was evidenced by the decline in species richness and abundance from 60 – 120 m to edge boundary. No differences were detected between 240 m distance and deep forest. These changes paralleled those of air humidity, temperature and forest structure. Most of the species captured in forest were negatively affected by the proximity of edge. Four species were positively affected including one species also present in savanna. A small number of species were recorded exclusively in savanna. Habitat specificity of the dung beetles in this study was high. Given the estimated penetration distance of edge effect into the forest (ca. 100 m) a three hectares fragment may be entirely under adverse edge condition. The sensitivity to habitat change showed by dung beetles make them a potential indicator group for monitoring studies in rain forest.

Selection of conservation priority sites for the fragmented Atlantic Forest at the Plateau of São Paulo (Brazil)

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The Brazilian Atlantic Forest has been identified as one of the biodiversity hotspots – but simultaneously this region tops the world statistics of habitat loss as it is restricted nowadays to approximately 98,000 km² of remnants or 7.6 percent of its original extension. On the plateau of São Paulo the Atlantic Forest is mainly found in relatively small fragments (< 100 ha), but nevertheless these fragments may play a fundamental role for the maintenance of biological diversity in this region. As it is neither economically nor socio-politically feasible to conserve every site that is of some biological interest, one of the central tasks of conservation biology is to target biodiversity protection efforts efficiently and to identify a set of sites which gives best the chance of conserving a wide array of species or other biodiversity features, while minimizing the area required and solving conflicts with competing land uses.

For the identification of a network of priority sites for the fragmented Atlantic Forest at the Plateau of São Paulo we applied a systematic biodiversity conservation planning process. Within this context we used abundance data of small mammals and frogs which were gathered in the forest fragments over a time period of two years as biodiversity surrogates and applied complementarity based algorithms (simulated annealing) for site selection. By carrying out numerous repetitions of the selection process we were able to identify a range of solutions. Sites which were selected in all simulations will be of high importance and might indicate irreplaceability for a regional conservation network, whereas sites which were selected less frequently reveal flexibilities with respect to site combination. But it became also obvious that the specification of biodiversity surrogates has tremendous influence on the efficiency of the selection process. Different taxon groups as well as abundance data from different years resulted in divergent site combinations and number of sites which are needed for a conservation network. From this it can be concluded that site selection based only on species data as biodiversity surrogates may be of only limited applicability as field records are mostly "snap-shots" in time. Instead, especially in fragmented landscapes, both temporal and spatial dynamics have to be included into the site selection process.

Analysis of vertical nutrient pathways and impacts on Taï National Park due to cocoa production

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In order to determine the influence of cocoa production in the agricultural dominated Hana sub-catchment on the ecosystem of Taï National Park, the vertical pathways of substances have been investigated comparing forest and cocoa sites. Inputs and pathways of nutrient ions, organic carbon and nitrogen species have been recorded, encompassing concentrations of precipitation and throughfall, as well as soil water (in 25, 65 and 105 cm depth), ground water and surface water solutions. These vertical chemical profiles reflect the main influencing factors such as geology, soils, vegegation and fertilizer (NPK) and/or pesticide application (mainly Endosulfane and Bassudine).

Based on the applied agrochemicals indicator parameters have been identfied (N, P, K, Cl, S). For example, within the soil solution in 105 cm depth (infiltration) the Cl concentrations at the forest site are 6.3 ppm and at the two cocoa sites 7.1 to 13.2 ppm. Though the nitrate concentrations are highly variable within the time series, both the input due to fertilizer and the input via pesticide application can clearly be identified reaching up to a maximum value of 19.4 ppm N in the soil solution in 65 cm depth at the younger cocoa plantation. In estimating the annual fluxes of the identified inidcator parameters of agricultural influences the identified differences between forest and cocoa plantations lead to the assumption that at least at the border of Taï National Park and along the course of the receiving stream (Hana) an influence of the cocoa production on the ecosystem of the Taï National Park is evident.

The data presented are results of the Taï region project on hydrology (2001-2004), an active cooperation between the Landscape Ecology unit of the University of Göttingen and CURAT of the University of Abidjan (funded by DFG).

Effects of hunting on seed dispersal and recruitment in a non-timber forest product

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The sustainability of seed harvest from natural populations has recently been questioned, as recruitment failure in *Bertholletia excelsa* was found to increase with the intensity of seed harvest. However, since areas where seeds are collected tend to also have intense hunting, we studied to what degree recruitment failure might be caused by reduced numbers of dispersers rather than by seed harvesting per sé.

We studied how hunting affected seed dispersal in crabwood (*Carapa* spp., Méliaceae), the seed oil of which is a highly-prized non-timber forest product of Guianan and Amazonian rainforests. Like *Bertholletia*, *Carapa* in terra firma forest depends on scatter-hoarding rodents for seed dispersal and seedling recruitment. Only the seeds that acouchies and agoutis remove from below parent trees and scatter-hoard in swallow, single-seeded caches in the soil surface may establish seedlings. However, in areas where seeds are collected for oil, these rodents tend to be heavily hunted as well.

We studied how hunting affected seed dispersal in *Carapa procera*. We measured seed crop size and the proportion of seeds were removed from below individual trees during three consecutive years, in two nature reserves and in two hunted areas in French Guiana and Suriname. The rate of seed removal and hence dispersal and survival decreased markedly with increased hunting levels to the point where *Carapa* may fail to recruit. The proportion of seeds dispersing was much less affected by the level of food availibility.

Our results suggest that recruitment failure may be at least partly due to the hunting that usually accompagnies seed harvesting, and not only to the harvesting itself. Seed harvest from natural populations will be more sustainable if accompagnied by measures adequately protecting seed dispersers.

Determinants of the Longitudinal Zonation in Decapoda (Crustacea) in Rivers of Palawan Island, the Philippines.

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This study focuses on the determinants of the longitudinal zonation in Decapoda from streams in the Philippines. The biotic data were obtained with colonization samplers and drift nets in two small rivers in Palawan including their estuaries and a riverine cave.

The longitudinal zonation patterns are illustrated by species congruity curves and Detrended Correspondence Analyses (DCA). The latter were correlated with the environmental variables water temperature, pH, electrical conductivity, dissolved oxygen, BOD, stream width, stream order, water depth, discharge, altitude, the site distance from the estuary and source as well as various descriptive variables for the substrates and for the stream hydraulics. The DCA produced best results when pooled data of colonization and drift were used and when mass occurrences of juveniles were excluded from the ordination. A complete species turn over from the headwater to the estuary was observed when unidentifiable juveniles had been excluded. Topographic features such as altitude, distance from the estuary were found to be the major determinants for decapod zonation in these streams. This was related to the findings that many decapod species are amphidromous or potamodromous.

Modelling the vegetation dynamics of forest fragments at the Atlantic Plateau of São Paulo.

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On the Atlantic Plateau of São Paulo only fragments of the Atlantic rain forests remain and even these are mainly secondary forests, due to clear cuts in the beginning of the 20th century. Simulation models, when combined with a strong empirical knowledge of local processes, provide excellent tools to investigate the effects of fragmentation on tree species diversity and vegetation structure. Therefore we apply and extend, as part of the German Brazilian research program BioCAPSP, the forest growth model FORMIND. This individual-oriented and process-oriented forest growth model simulates the spatio-temporal dynamics of uneven-aged mixed 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. The carbon balance of each individual tree is modelled explicitly. To cope with the high number of species, the model simulates the dynamics of plant functional types instead of single species. The plant functional types differ in their shade tolerance (intolerant, intermediate, tolerant) and their maximum potential height. We will present the basic concepts of the model and its special adaptations to the specific situation at the Atlantic Plateau of São Paulo. Simulating fragments with different size and degree of isolation, will lead to a better understanding of fragmentation effects on tree species diversity and the long term vegetation dynamics. This will serve as an important basis for biodiversity maintenance in the entire fragment mosaic.

Fruit and seed morphology and anatomy of Loasoideae (Loasaceae) and their ecological implications

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A recent study of fruit opening mechanism, seed morphology, seed sizes and fatty acid composition (Weigend et al., FLORA 199: 424—436, 2004) demonstrated the presence of unexpected variability in these characters in Loasaceae subfamily Loasoideae. The present study aims at placing these data into the context of fruit and ovary morphology in and attempt to evaluate possible ecological adapations. Examples from eight species corresponding to five genera (*Blumenbachia, Caiophora, Loasa, Huidobria* and *Nasa*) are illustrated. Four of the genera (*Caiophora, Loasa*, *Nasa* and *Huidobria*) have xerochasious capsules, opening mode is by apical valves in *Loasa, Nasa* and *Huidobria*, but with 4—7 longitudinal sutures in *Caiophora*. *Blumenbachia* has capsules which open with ten longitudinal sutures, but these are not xerochasious. Moreover, whereas the fruits of the other four genera remain firmly attached to the infructescence and the seeds fall out, the fruits of *Blumenbachia* become detached from the mother plant and are dispersed as a unit. Placentation is usually intrusive parietal, but the exact shape of the placentae depends both on fruit opening mode and morphology and on seed number. *Huidobria* has 4—5 placentae which are triangular in section, and thus have a massively increased surface. Numerous ovules find room on these placentae and a single fruit produces in excess of 3.500 tiny seeds. Both *Nasa* and *Loasa* the 3—5 placentae are round in transverse section and the seeds are noticeably larger and fewer (typically 30—150). Placentae in *Blumenbachia* are lamelliform and have room for only few ovules, the capsule wall is thickly parenchymatous and spongiose in structure and the fruits are easily rolled by wind and, once dry, float on water. *Caiophora* diverges furthest form the typical fruit morphology, the placentae are here Y- or T-shaped with seeds only on their proximal surfaces and the placentae more or less concrescent in the centre of the fruit, so that the seeds remain locked between the placental tissued and the longitudinal sutures. The seeds are thus held in a hanging basket which requires dry wheather and strong wind to release the seeds and thus limits seed dispersal to optimal conditions for anemochory. The examples here illustrated show that within Loasaceae subfam. Loasoideae we have a wide range of fruit/seed syndromes: xerochasious capsules with huge amounts of tiny dust-seed on enlarged placentae (*Huidobria*), xerochasious capsules with medium sized balistochorous seeds on moderatly

Light Management as a Tool for Conservation and Sustainable Management of Podocarpaceae in the Buffer Zone of Podocarpus National Park, Southern Ecuador

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Many authors consider the species from the family *Podocarpaceae* in Southern Ecuador as highly endangered due to extreme exploitation and deforestation. Despite the very high timber value of the *Podocarpaceae* the knowledge of ecological behaviour and silvicultural management techniques of these species is very limited.

Therefore we studied the population structures and aspects of light ecology on four sites in the buffer zone of the Podocarpus Nationalpark. At each site we established ten plots using the relascope method from Bitterlich for a general characterisation of the stands. Additionally, 10 plots per site with 1000 m² each were established for registration of all *Podocarpaceae* with DBH > 20 cm. Smaller individuals, from seedlings up to trees with DBH = 20 cm, were sampled in smaller subplots (100-500 m²). The relative light intensity (RLI) was calculated for each plot at four points by similtaneous measurements of PAR-radiation inside and outside the forest at 0 m, 1 m and 3 m height. Additionally, we measured light conditions for every regeneration plant of *Podocapaceae* up to 3 m height. Survival and growth were observed during one year.

The results show that the relative light intensity had no effect on survival of regeneration of *Podocarpus oleifolius* and survival rate was independent of plant size. Contrarily *Prumnopitys montana* had a survival rate of only 21,4 % with relative light intensities lower than 4 % but 83,3% at areas, brighter than 4 % RLI. There is also a relation between plant size and survival: plants taller than 8 cm had a higher survival rate (100%) than smaller ones (26,3 %). We found a significant positive correlation between plant size and RLI for *Prumnopitys montana* and *Podocarpus oleifolius*. The results show that light is an essential ecological factor for natural regeneration of *Podocarpaceae* in the study areas. Silvicultural measures therefore can contribute to sustainable management and conservation of the endangered species of this family in the area of the Podocarpus National Park.

Correlation of relief and vegetation in northern Ivory Coast on the basis of a digital elevation model (DEM)

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Being one of several studies on dynamics and functional relationships of the widespread and anthropogenically altered mosaic of forest islands and savanna in the Guineo-Sudanian transition zone of West Africa, an analysis of relief and vegetation pattern was performed for parts of the Comoé National Park (CNP) and adjacent utilized regions, focusing on the distribution of the forest islands in the savanna. It was part of the interdisciplinary research program BIOTA Africa of the German BMBF.

Firstly, a multitemporal multispectral classification of satellite images was performed to create vegetation and forest maps. Subsequently, the vegetation signal was removed from an existing DEM by filtering the DEM and removing the forests by means of a forest mask. Different kinds of vegetation masks and the corrected DEM were the basis for the analysis of the correlation of relief and vegetation. Furthermore, an analysis of the texture performed on the original DEM showed further possibilities of distinguishing different vegetation types referring to the degree of structural uniformity of their topmost layers.

The relief analysis revealed differences in the position of different vegetation types: The forest islands and savanna woodlands are predominantly located on hills and slopes with, referring to the topographic wetness index (TWI), low soil humidity, whereas the gallery forests are located in low and flat areas with high soil humidity. Tree savanna and shrub savanna are located in intermediate areas with moderate soil humidity. The texture analysis showed a high structural diversity of the island forests, which are characterized by a high spatial diversity, and a low diversity of the gallery forests, which are characterized by a slightly varying canopy structure. The textural diversity of the savannas decreases corresponding to a declining share of trees.

The satellite image and DEM evaluation carried out showed various possibilities for the analysis of relief and vegetation on a regional scale, especially in tropical regions, which are difficult to gain access to. The results are potentially transferable to topologically and ecologically similar regions of Africa.

Effects of rain on herbivory rates in a tropical lowland rainforest

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Undoubtedly, rainfall is an environmental factor that plays a prominent role in tropical rainforests. Nevertheless, the direct, physical impact of raindrops on organisms and ecological processes was hardly investigated. Here we studied the proximate effects of rain on herbivorous activity in a semidecidious tropical lowland rainforest in Panama. In particular, the objective was to asses how rain influences the activity of 1) the leaf-cutting ant (LCA) *Atta colombica*, a generalist herbivore, and 2) *Zunacetha annulata*, a specialist caterpillar of the understorey shrub *Hybanthus prunifolius*. The investigations included field observations during natural rain events and experimental studies, i.e. sprinkling herbivores with a 'rain-simulating shower'. The results showed, that rain leads to an exponential decline of the foraging activity in LCA and that the extent of the reduction depends on duration and intensity of rainfall. During short natural rain events, ants sought shelter at or nearby the host plant. With longer rain durations an increasing number of ants started to return to the nest and re-activation of foraging was considerably delayed. Consequently, depending on the duration, intensity, and the exact timing of rainfalls (relative to the daily course of activity), total harvest rates of LCA can be drastically reduced due to a prolonged inhibition of mass recruitment. In contrast rain-simulation experiments with larvae of *Z. annulata* revealed that feeding was entirely suspended during rain but resumed almost immediately after rainfall ceased leading to minimal overall feeding losses. We conclude that rain may be a relevant factor affecting the feeding activities of herbivores, especially in high precipitation climates or seasons. Nevertheless the resulting feeding losses greatly depend on the identity of the concerned herbivore, its foraging mode, and the recovery period of the primary feeding rates.

Distribution patterns of the genus *Piper* (Piperaceae) along an altitudinal gradient in a South-Ecuadorian montane rain forest

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This field research is part of the DFG-funded project "Functionality in a Tropical Montane Rainforest: diversity, dynamic processes and utlilization potentials under ecosystem perspectives". The studies were conducted between March and July 2004 in the area of the Estacion Cientifica San Francisco (S03°58',W79°04') which is situated on the eastern slope of the Cordillera El Consuelo in Southern Ecuador. The data were obtained from 15 permanent plots (size 20x20m) along an altitudinal gradient between 1850m and 2450m m.a.s.l. All (morpho-) species of the genus *Piper* were registered with height and diameter. 701 individuals belonging to 21 species were counted and identified. Data on abiotic factors obtained by former investigations were used to explain observed distribution patterns.

Preliminary results indicate no significant impact by the altitudinal gradient on the number of species per plot. Species appear to be either accumulated on specific plots or more or less evenly distributed over all plots. Only little variation in species composition along the altitudinal gradient could be observed.

There are significant differences in species composition and distribution between ridge and ravine forests. The overall species richness is higher in the ravine forests plots. About half of the species identified are exclusively abundant in the ravines whereas the other half are common species in both, ravines and ridges. Ridge forests comprise only a small amount of unique species. The means in the number of individuals and species of *Piper* per plot are significantly larger in the ravine forests.

Triggered pollen presentation, timing and pollination in Loasaceae subfam. Loasoideae

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Loasaceae subfam. Loasoideae comprise approximately 200 spp. and are a nearly exclusively South American plant group distributed from sea level to over 4500 m in the Andes. They have complex flowers with various pollination syndroms. While a basic understanding of the floral function has been obtained in the past few years, many details of floral biology remain unexplored. Functional floral morphology of Higher Loasoideae was first investigated by Urban (Ber. D. Bot. Ges. XX: 22—27, 1886), but the discovery of the thigmonastic stamen movement in some Loasoideae was only made very recently. These thigmonastic stamen movements, i.e. the triggered pollen presentation, are crucial to an understanding of floral function in this group. Stamen movement is triggered by manipulation of the floral scale for the purpose of nectar harvest by flower visitors. Published data report thigmonastic stamen movement in a total of nine species of the genera *Loasa, Caiophora* and *Blumenbachia* from Argentina and Brazil. These data indicated a connection between thigmonasty and specialized pollinator behaviour, typically of Colletid bees. The present study reports detailed observation on stamen movement in an another 14 species of Loasoideae, including representatives of additional genera such as *Nasa, Aosa* and *Presliophytum* and additional species groups in the *Caiophora* and *Loasa*. Experiments with 30 min intervals between scale manipulations led to the movement of typically one mature stamen after ca. 1 min. After each manipulation no mature stamens can usually be triggered for an interval of ca. 20—30 min. The data on thigmonasty clearly show that there is a distinct time-frame for the stamen movement, making the timing of pollen presentation predictable for the flower visitor. Additionally, we found that, surprisingly, large and orange-coloured flowers in *Caiophora*, which have been traditionally associated with ornithophily, show similar patterns of stamen movement. Pollinator data indicate that ornithophily may be restricted to fewer taxa in Loasoideae than hitherto believed. Thigmonastic stamen movement seems to have arisen early in the evolution of Loasaceae subfam. Loasoideae and may have been a key invention in the evolution of the group.

Effect of lactation on the nocturnal activity pattern of a small neotropical fruit bat, *Rhinophylla pumilio* (Carolliinae), in French Guiana.

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Bats are typical income breeders. During lactation, females rely on current resource intake to support costs of reproduction and so must reconcile the conflicting demands of foraging and nursing. In this study, we hypothesised that after parturition, females will reorganise their nocturnal time budget so as to meet the temporal, behavioural and physiological constraints imposed by lactation. We used as a study model the small neotropical fruit bat *Rhinophylla pumilio* (Carolliinae) which is the main dispersal agent of epiphytic Araceae and *Philodendron spp* (Cyclanthaceae) in the primary forest of the Nouragues reserve, French Guiana. Four non-reproductive and four lactating females were fitted with transmitters and radio-tracked during five consecutive nights. Tracking nights consisted in permanently reporting the alternation of activity and perching bouts of bats and locating perching sites by triangulation. We used the following parameters to describe their nocturnal activity pattern: duration of activity bouts and perching bouts, cumulated activity duration, sizes of foraging and core areas, flight distances and cumulated flight distances. Accordingly to our hypothesis, lactating females adopted an activity pattern that differed in many regards from that displayed by non-reproductive ones. They significantly reduced their foraging area and flight distances, and maintained a high activity level all night long while non-reproductive females spent more time inactive after midnight. Moreover, our data suggest that the increase of food intake required for milk production is permitted by longer feeding phases on infructescences of epiphytes. The observed activity pattern of *R. pumilio* is consistent with the "Central" and "Peripheral" Limitation Hypotheses which state that the sustained energy intake is intrinsically limited by the rate at which organisms acquire, process and expend energy. This might explain why lactating females are compelled to stagger feeding bouts over the whole night whereas a single ripe epiphyte infructescence may provide more pulp than what they actually nightly consume. Such nocturnal activity pattern is likely to explain in part the sensitivity of *R. pumilio* to habitat disruption. Furthermore, it helps to understand the spatial pattern of seed rain mediated by these bats.

Change of Ecuadorian arctiid communities with forest succession: gross taxonomic composition and biotic defense

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Arctiid moths are among the most species rich families of Lepidoptera on Earth, with peak diversity in Neotropical rainforests. They are subdivided in subfamilies and tribes which differ strikingly in morphology and many life-history attributes. We expected that diversity and distribution of these taxa varies across habitats in a gradient in the montane forest zone (1800-2000m) of southern Ecuador. To test this idea we studied speciose Arctiidae ensembles (287 species altogether) at 15 succession habitats and six forest understory sites. Moths were attracted to a 30W light source, sampled quantitatively and identified to species level.

Representation of higher taxa was uneven: Phaegopterini 135 spp. (47%), Ctenuchini 82 (29%), Lithosiinae 54 (19%), Pericopini 9 (3%), and Arctiini 7 (2%). With regard to the representation of these subfamilies and tribes, there were only minor differences between habitat categories. Proportions of Phaegopterini remained unchanged, Lithosiinae slightly decreased towards forested habitats, whereas Ctenuchini increased with forest recovery. Local diversity (Fisher's α, mean ±1 SD) was high and dominated by Phaegopterini (α=26.6±9.6), followed by Ctenuchini (α=12.8±3.1) and Lithosiinae (α=8.3±2.5). Only within Phaegopterini diversity decreased from early succession sites (α=31.0±9.1) across later stages (α=26.9±3.0) to mature forest understory (α=18.9±10.1). Among Phaegopterini, Ctenuchini and Lithosiinae dominance of the commonest species was higher in mature forest than at succession sites, while proportions of singletons did not differ between the habitat classes. There was a taxonomic difference in the extent of rarity: singletons and doubletons together made up about 30% of Ctenuchini and Phaegopterini ensembles, but only 15% in Lithosiinae. Ordinations (non-metric two-dimensional scaling, Gallagher's CNESS index) revealed a significant segregation between ensembles of succession sites and the forest understory for all larger subordinated taxa (Phaegopterini, Ctenuchini, Lithosiinae).

We scored all 287 species according to their external appearance as either cryptic (dull wing colors: 79% of all species) or aposematic (brightly colored wings and/or abdomen, Hymenoptera mimicry, metallic shine: 21%). Overall the incidence of aposematism in arctiids did not change along the succession gradient, but such patterns became apparent at lower systematic levels. Aposematic species among Phaegopterini and Lithosiinae were more prevalent at succession sites than in mature forest, whereas Ctenuchini showed the reverse picture. Our results indicate that within Arctiidae variation in morphology and life-history attributes across subfamilies and tribes is reflected ecologically by the micro-distribution of these higher taxa along environmental gradients.

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Mixing Africa and Europe – Speciation Processes in Grasshoppers from the Canary Islands

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Subtropical volcanic islands represent excellent study areas for colonization and speciation processes. The Canary Islands are characterized by a fauna mixed of Afrotropical and Mediterranean elements. The genus *Sphingonotus* (s.l.) occurs here with approximately ten species, five of which are endemic. The phylogenetic relationships of these species were analysed based on molecular data (mtDNA sequences). Two lineages could be resolved. The African lineage is related to *Sphingonotus airense* from Niger, including the former Gran Canarian endemic *Sphingonotus sublaevis*, which turns out to be synonymous with *Wernerella pachecoi* from Lanzarote, Fuerteventura and Morocco. *Pseudosphingonotus savignyi* is a young sister group to this species; both again are sisters to *Wernerella rugosa*, an older endemic species from Lanzarote and Fuerteventura. The second (Eurasian) lineage includes the ancient relic *Wernerella picteti* (endemic to Tenerife and La Gomera) and the very young *Sphingonotus caerulans* group, including a high number of Mediterranean taxa. This group could not be resolved, although a fast evolving gene has been used (ND5). Apparently, the group represents a young radiation with clear bioacoustic differences, but poor genetic resolution, comparable to the Chorthippus biguttulus group. *Sphingonotus willemsei*, a species endemic to the Cañadas on Tenerife, is included in this clade. *Wernerella guancha* (endemic to Gran Canaria) is an ancient relic with uncertain affinities. A completely different example is that of the flightless genus *Arminda*, which occurs with seven endemic species on the Canaries. These species are ancient lineages with a high genetic distance. They show a clear branching pattern from east to west.

Tree regeneration within natural canopy gaps in a South Ecuadorian montane forest

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The field research for this study is carried out within the German research group "Functionality in a tropical mountain rain forest: diversity, dynamic processes and utilization potentials under ecosystem perspectives" in the forest of the Reserva San Francisco (S 3° 58´, W 79° 04´) which is located on the eastern slope of the Cordillera El Consuelo in Southern Ecuador.

To investigate the importance of canopy gaps for woody plant regeneration two distinct forest types (ravine forest vs. ridge forest), both at the same elevation (1950-2100 m above sea level), were chosen to install six permanent transects (each containing 41 subplots of one m^2). The cross-shaped transects are situated within natural canopy gaps and cover different light conditions from totally open canopy over gap edge to closed canopy.

In a first census all regeneration of woody plants (height ≥5 cm) rooting inside the plots was inventoried with height, leaf number and proportional leaf damage by herbivores. Plant determination in most cases was only possible to family or genus. Microclimatic site parameters like soil and air temperature, humidity and light conditions (PAR) were quantified.

The five most important plant families within the young plants registered on the plots were Rubiaceae, Melastomataceae, Lauraceae, Arecaceae and Mimosaceae. The first three of them in earlier studies were found to be the species-richest tree families of the area. There were clear differences between the two forest types, the numbers of plant individuals in the ravine (mean = 142 / 41m^2) were significantly lower than on the ridge (mean = 314 / 41m^2). Arecaceae were principally found on the ridges whereas Mimosaceae are restricted to the ravines.

In the gap centers extreme conditions with high variation of soil and air temperatures are found, whereas underneath closed canopy conditions are more constant.

A second census after one year shows how the specific site conditions influence growth and mortality of the woody regeneration. For both forest types turnover rates are high, and seem to be dependent on light availability.

Conflict Patterns of Resettlement Communities in Indonesia: Findings from Transmigration Projects in Central Sulawesi

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The Indonesian resettlement scheme transmigrasi was established to decrease poverty and unemployment in the 'overpopulated' areas of Java and Bali and to transfer land use techniques to the so-called Outer Islands of the archipelago. Furthermore, the living conditions of the resettled families should be improved. Critics point out, however, that in many cases the natural potential of the chosen resettlement sites were low and the preparation insufficient. For two reasons the Lore Lindu Region of Central Sulawesi appears to be an interesting site for the investigation of conflict patterns of transmigrant communities. First, the transmigration projects there were implemented comparatively late at the beginning of the 1990s, so one could expect that experiences with former resettlement programmes have reduced potentials of conflicts. Second, the establishment of the Lore Lindu National Park (LLNP) and the on that account increasing shortage made the region more conflict prone in terms of struggles for agricultural land.

In order to analyse conflict patterns of such transmigration projects, within the framework of the collaborative research programme SFB 552 – STORMA (sponsored by the German Research Foundation – DFG) we conducted a research in two transmigration settlements in Central Sulawesi. A census and interviews with selected households in the transmigrant communities as well as interviews with key informants of both, the transmigrant and the adjacent villages were used for gaining the relevant data. Besides, interviews with experts of the Department for Transmigration were conducted.

Our findings justify the general conclusion that integration of the migrants has not been achieved. In both villages out-migration set off shortly after the resettled families had arrived. The persisting households used a variety of strategies, including off-farm activities and forest clearing, to secure their livelihoods. The encroachment into the nearby LLNP and the clearing of secondary and primary forest is one potential of conflicts resulting from failures in project planning, implementation, and maintenance. If, in addition, the financial and material support for the resettlers is not provided, the struggle for survival leads to unsustainable use of the resources without another choice. The inferior political position of the migrants holds another likely conflict. Due to their status as 'migrants', they lack bargaining power in negotiations with the local communities. This has an impact on the use of the natural resources because the transmigrants are not able to cultivate their allocated land and, secondly, they are forced to move to another location inside the primary forest.

Determinants of small scale diversity of under storey plants and epiphytes An example from a North-Eastern Amazonian lowland rain forest

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Since many years there is an ongoing debate concerning the factors determining tropical rain forests diversity. One of the most popular ideas is Hubbell's neutral theory (Hubbell 2001) stating that tropical tree species diversity is governed exclusively by chance effects like distance related dispersal limitations. Contrarily, Tuomisto et al. (1995) proved that beta diversity in Amazon lowland forests is mainly controlled by soil factors. It has been recognised, that both, Hubbell's theory and Tuomisto's findings are partly scale dependent. Hence, clearly more research is needed.

In this context we present some results of a study carried out in a lowland rain forest in the Amazonian part of Venezuela. Abundance and/or cover of under storey plants and epiphytes were recorded in twenty sampling plots (20 by 20m). The maximum distance between the plots was 700m. The positioning of plots covered a gradient from regularly (several days per year) to very rarely flooded sites (once a decade).

We analysed alpha and beta diversity and correlations with environmental variables (distance between plots, topography, canopy openness, and some physical soil parameters) using univariate and multivariate statistical methods.

The main results are: (1) alpha diversity is very weakly correlated to the environmental variables studied. (2) beta diversity is significantly correlated to some hydrological and soil variables, as well as to the distance between plots.

Besides, we found a positive correlation between beta diversity of trees and under storey species.

The results suggest that at this small scale environmental factors and distance dependence (= dispersal limitations) both contribute significantly to explain diversity patterns of under storey plants and epiphytes in the study area.

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Genetic Relationship in groups of a cooperatively breeding primate

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Co-operative breeding is rare in mammals, but consistently found in the New World primate sub-family Callitrichinae (marmosets and tamarins). Due to the scarcity of genetic studies of wild callitrichines, it is not known whether this co-operation is based on kin selection or on other benefits. We therefore studied genetic relatedness in wild groups of moustached tamarins (*Saguinus mystax*). These tamarins live in groups of 1-4 adult males and females each and show a polyandrous mating system, with reproduction usually being confined to a single female per group. We used 12 microsatellite loci of DNA extracted from faecal samples collected from two major study groups and six neighbouring groups at the Estación Biológica Quebrada Blanco, north-eastern Peru, for genetic analyses. Relatedness between individuals within groups was significantly higher than between members of different groups., though both unrelated males and females (apart from mating partners, which were never related) occurred within groups. Thus, the co-operative breeding system of *S. mystax* may be partially based on kin selection, but other benefits have to play a role as well.

Key processes for tree species richness in tropical rain forests

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In this study we investigated how disturbance and recruitment limitation influence tree species richness in a tropical rain forest. Most investigations on species richness were so far performed with simple conceptual models in which main competing processes were not represented adequately. Therefore, we analysed this question with the process-based forest model FORMIND2.0. The model simulates the spatio-temporal dynamics of an uneven-aged mixed forest stand in Sabah, Malaysia. It calculates the carbon balance of individual trees, competition for light and space, and covers recruitment processes by explicit seed dispersal.

The impact of recruitment limitation and gap disturbances on the richness of the 468 tree species of the forest site were assessed in detail. In cases without recruitment limitation cumulative species numbers per cumulative stem numbers did not vary with disturbance, while in recruitment limited scenarios species numbers were higher in forest sites with less disturbances. These results show that both processes influence tree species richness and both processes are linked.

Climate change and resource allocation in Andean species of *Lepidium* (Brassicaceae): possible effects on species maintenance and migration.

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As a result of current climatic change temperatures are rising, affecting plant growth, especially in extreme environments such as those at high elevations in the Andes. Global climate change is expected to lead not only to higher temperatures but also to altered precipitation regimes, which will force species to either migrate upwards or to adapt themselves. It is likely that the migratory response of some species will not be fast enough to encompass these changes and thus their maintenance will be decided by their temporary adaptativeness to the new environmental conditions. In order to address the question on how climate change might alter plant growth in high Andean ecosystems we cultivated two species of *Lepidium* (Brassicaceae) (*L. meyenii*: natural distribution 4050-4600 m; *L. bipinnatifidum*: 3100-3900 m) at two sites (3100 m, 4100 m). For *L. bipinnatifidum* we simulated the move to higher elevations (invasion), whereas for *L. meyenii* the shift was to lower elevations (maintenance). We centred our observations on the establishment and juvenile stages. For *L. meyenii*, the transplantation to lower elevations led to a greater biomass production of the seedlings in comparison to seedlings growing within their natural ranges. The seedling located at the upper site invested nearly 70% of their dry weight in roots and 30% in above-ground biomass, while the seedlings from the lower site showed the opposite pattern. For *L. bipinnatifidum*, the cultivation at higher elevations reduced the biomass, but did not change the resource allocation pattern, which was about 50% to roots and shoots in both localities. Comparing the two species, there was no statistical difference in the dry weight at each of the two cultivation sites. The elevational distribution of both species seems not to be limited by mean temperatures but by their ability to shift resource allocation patterns, determining their ability to cope with extreme climatic events (frost, drought). While a greater allocation to below-ground structures confers frost- and drought-resistance, the change in *L. meyenii*, and the maintenance in *L. bipinnatifidum* of resource allocation patterns suggests that in a future global change scenario, were climatic extremes may be more common, the species' response could therefore not be a simple shift of elevational ranges, but likely result in an overall reduction of range sizes.

Local scale spatial distribution and floristic patterns of tropical Araceae. Comparison among growth habits.

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Despite of the importance of non-woody plants in the diversity and structure of tropical lowland forests, to date few information about their spatial distribution patterns at local scale is known. To establish differences in the spatial distribution patterns, community structure and composition, and the relative importance of habitat heterogeneity or dispersal processes at local scale between epiphytic, hemiepiphytic and terrestrial plants, we studied the Araceae community in a tropical forest in Chocó, Colombia. In 25 plots of 400 m^2 within an area of 1 km^2, we registered all Araceae individuals. For each growth habit group we calculated: species-acumulation curves (observed, MMMeans and Coleman) , the number of plots occupied by each species, and established if composition changes in the community were correlated with the inter-plot distance. Estimations showed that sampling was almost complete for epiphytic and hemiepiphytic species, but that ca. 20% more terrestrial species are expected with a more intensive sampling. The studied Araceae showed aggregate distribution patterns , which is most evident for terrestrial species. The epiphytes were most regularly distributed, being registered in more plots than the hemiepiphytes, while the terrestrial species were the most restricted. Changes in species-composition were correlated for epiphytes and hemiepiphytes with the inter-plot distance. Based on the observed patterns, it can be postulated that for terrestrial Araceae, the floristic composition would be principally determined by habitat heterogeneity at local scale such as topography, soil composition and drainage. It is interesting to observe that although most of the hemiepiphytic aroids also occur as terrestrials, at least as seedlings and juveniles, their spatial distribution pattern differs considerably from that of the terrestrial communities, being more similar to the pattern of the epiphytes. This suggests that, in contrast to the terrestrials, hemiepiphytic aroids could have no particular substrate preferences for germination and establishment. Possibly, this apparent greater tolerance of hemiepiphytes to different substrate in this forest could be explaining the greater diversity and abundance of this growth habit group in contrast to the others. The results suggest that the aggregation degree and the distribution amplitude of the species determine the patterns observed in the species accumulation curves and the floristic composition of the Araceae community in the Chocó forests.

Floral diversity of a sucessional plant community in the Atlantic rainforest region in Pernambuco/Brazil *

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Fieldwork was carried out at the São José sugarcane-plantation from May to September 2004 within the binational Mata Atlântica program. We studied the functional diversity of flowers of an approximately 25 year-old successional plant community of a size of 120 ha, which is a complex habitat influenced by former and current human activities. The most important impacts are a dam construction, resulting in a swamp area, as well as fire and soil-degradation of different intensity levels due to long-term cultivation of sugarcane, with secondary forests mixed with open sites. The various degrees of human influence are also indicated by differing numbers of non-native plant species in each sub-habitat: the swamp is dominated by the anemophilous *Urochloa mutica* (Poaceae), the most dominant zoophilous species is the sphingophilous *Hedychium coronarium* (Zingiberaceae), both of Paleotropic origin. The functional diversity of flowers in this area is limited to only 4 different flower types (tube, dish to bowl, funnel, gullet), whereas the two other sub-habitats show more flower types (additionally pseudanthium, brush, flag, trap, malpighiaceae- and sterculiaceae-style). Main floral resource provided by swamp plants is nectar, whereas pollen-offering species, such as the melittophilous *Gustavia augusta* (Lecythidaceae) or the probably cantharophilous *Eleais oleifera* (Arecaceae), growing the forest or open areas are absent, as well as the melittophilous *Stigmaphyllon blanchetti* (Malpighiaceae) exhibiting oil. The two species with trap-flowers, the Asclepidiaceae *Blepharodon* cf. *nitidum* and *Aristolochia papillaris* (Aristolochiaceae) are not occurring in the swamp but in the forests, the first also in open sites. Obviously, more disturbed areas show a smaller spectrum of floral diversity and resources, still the non-native *H. coronarium* is the only proven sphingophilous species found in the examined area.

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Reproductive modulation of stress sensitivity may impose selective bottleneck on New and Old World tropical Chiroptera in times of climate change

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In tropical environments with low annual temperature amplitude, extremes may have critical impacts on ecosystem performance. Physiological stress responses in tropical vertebrates to these environmental challenges have been shaped by natural selection to facilitate survival. Current scenarios on climate change, however, project a rapid regional increase in climatic variability. Recent findings have shown for instance an increase in both frequency and intensity of extreme heat events along the Australian East coast, and an increase in the frequency of El Nino events leading to drier wet seasons along the isthmus of Panama.

To compare the role of reproductive activity in modulating the stress response under different environmental conditions and to assess the potential impact of extreme climatic events on tropical bat populations, we selected three species of tropical bats for field studies conducted from 2001-2003. In the New World, we studied a population of Common Fruit-Eating Bats (*Artibeus jamaicensis*) in Central Panama and in the Old World, a population of Grey-Headed and Black Flying Foxes (*Pteropus poliocephalus* and *P. alecto*). We hypothesized that higher variance in reproductive investment in females resulted in elevated stress sensitivity, then females should be particularly vulnerable to climatic stress.

Glucocorticoid stress response dynamics of the Panamanian bat population (N=326) showed a dramatic increase in stress sensitivity in reproductively active females. This change in sensitivity was independent of seasonality and body condition. However, within the study period, no extreme climatic fluctuations occurred in Panama, whereas in Australia we witnessed selective mass mortality in the flying fox population (N~30.000). Here, it was predominantly reproductively active females and young which died in response to extreme heat waves.

Our results indicate the possibility of a selective bottleneck for population demography which in times of climate change may negatively affect reproductively active females in their physiologically more vulnerable condition. Effectively, this will, when such climate events will occur more frequently in this century, reduce breeding populations of tropical Chiroptera. In the long run, it will probably also reduce their distribution ranges and therefore important ecosystem services they provide, namely seed dispersal and pollination. These effects are likely to affect a wide range of taxa increasing their probability of going extinct.

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Modulation of the corticosterone stress response by reproduction in a frugivorous Neotropical rainforest bat (*Artibeus jamaicensis*) in Panama

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Changes in reproductive state or the environment may affect sensitivity of the hypothalamic-pituitary-andrenal axis (HPA). However, little is known about the dynamics of the resulting corticosteroid stress response, in particular in tropical mammals. We addressed the modulation of corticosterone release in response to different reproductive conditions and seasonality in 301 free-living, common fruit-eating bats (*Artibeus jamaicensis*) on Barro Colorado Island in Panama during dry and wet season. We present strong evidence that reproductive condition directly and seasonality at the most indirectly modulates stress sensitivity. In reproductively active females, increase in corticosterone was more rapid, and reached higher levels, but also decreased significantly faster than in inactive females. In reproducing males, the corticosterone response was less strong than in females and delayed compared to non-reproductive males. Testes volume in reproductively active males was negatively correlated with corticosterone concentrations. Our findings suggest differentiated dynamics in the corticosterone stress response between sexes, potentially reflecting conflicting ecological demands. In females, a strong acute corticosterone response may represent high stress- and risk-sensitivity which facilitates escape responses and thus preventively helps to protect reproduction. In males, suppression during reproductive activity could reflect lowered stress sensitivity to avoid chronically elevated corticosterone levels in times of frequent aggressive and therefore costly inter-male encounters.

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.

Bryophyte cover on trunks and branches – a proxy for air humidity in the tropics?

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Climatic variables are one of the most important constraining factors for species assemblages and richness patterns of species in the tropics. Among them, air humidity contributes to a high degree to the climatic environment, but its assessment is hampered by the high effort in direct measurement. In many studies, the coverage of epiphytic bryophytes is used as a proxy for air humidity, because as poikilohydric organisms they are believed to reflect humidity conditions (Frahm & Gradstein 1991). Within an elevational transect study on pteridophyte species richness in Costa Rica, we measured air humidity at four locations (40 m; 650 m; 1800 m; 2800 m) and estimated the bryophyte cover on trunks and branches at 156 locations between 100 m and 3300 m to compare the resulting data.

The elevational lapse of air humidity was hump-shaped with a maximum at mid-elevations (~1800 m). Bryophyte cover increased up to that elevation, but remained high up to the upper forest line (3300 m). Correlation between lapse of bryophyte cover and air humidity decreased with increasing elevation from 0.96 ($p=0.002$) at 0 – 650 m to –0.45 ($p=0.17$) at 1800 – 2800 m. That means that above the condensation level (> 2000 m) decreasing rainfall and strong winds lower the air humidity, but this does not affect bryophyte cover. Drought occurrences at high elevations are reflected by high frequency of xeromorphism in shrubs, trees and pteridophytes, and low values of vegetative productivity of pteridophytes. This raises the question of why bryophytes can thrive in an environment that is clearly not beneficial to pteridophytes, especially epiphytic ones.

Our data support the notion that up to the condensation level average air humidity can be assessed by bryophyte cover. Above that level with increasing elevation such an assessment should be made with care.

Towards a sustainable use of East African rain forests BIOTA East Africa: an integrated approach

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BIOTA East Africa links a set of thematically co-ordinated analyses of biodiversity changes in East African highland rain forests. Investigations take place along a fragmentation/disturbance gradient and include various types of habitats - from moderately disturbed primary forest to secondary forests and completely degraded areas. Research is aimed at a better understanding of the complex consequences of changes of biodiversity on different hierarchical levels resulting from exploitation and fragmentation. Warranting a maximum maintenance of biodiversity and its function as well as promoting the compatible use of biological diversity with profit for local populations is the overall goal. Major aims are defined as follows:

- Analysis of changes of biodiversity and ecosystem function along gradients of degradation
- Analysis of changes of economic use of habitats along these gradients
- Identification of an optimum relation between maintaining a high level of biodiversity and a tolerable economic profit from forest use? - point of sustainability
- Innovations for sustainable use of biodiversity and biodiversity management; development of recommendations and information policy according to the aim of fair benefit-sharing

The study mainly takes place in Kakamega Forest, Kenya, and the Budongo Forest, Uganda.

The impact of land use on landscape heterogeneity and plant diversity – issues of scale

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A meaningful interpretation of landscape structure is only possible when the characteristics and limitations of the measures are understood and the range of attainable values is known. In many recent articles, which deal with landscape measures issues of resolution and scale are usually assumed to be important but rarely tested. In our first approach we use satellite based land cover maps at different resolution and scale to compare values of landscape heterogeneity between regions with different human utilization pressure in the North Sudanian Zone of Burkina Faso; West Africa.

In a second approach we model the predicted distribution of more than 120 plant species (GARP software) in our study area. Derivative satellite data (Landsat ETM+) and a digital elevation model were used as explaining variables to extrapolate the species observation points of several hundred phytosociological records to the landscape scale. Consequently a map of the predicted phytodiversity was calculated. To examine the behaviour the map of predicted phytodiversity in relation to spatial scale we generated map series of different spatial resolution.

In conclusion we combine the results of the two approaches to quantify the impact of land use on landscape heterogeneity and phytodiversity. This study is part of the framework Biodiversity Monitoring Transect Analysis (BIOTA, Subproject W11, West Africa; http://www.biota-africa.de).

Populationdynamics of an ecosystem engineer, the fungus cultivating termite *Macrotermes bellicosus* in West-Africa: Analysis of a longterm study

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The regulation mechanisms of tropical ecosystems are not well understood. With the biodiversity debate, interests centered around rainforests and new types of models were developed that place a high emphasis on stochastic factors and neutral processes. Savanna ecosystems were rarely considered in this debate. In a longterm study, I was investigating the regulation and population dynamics of a key species, the fungus growing termite *Macrotermes bellicosus*, in a West African savanna, the Comoé Nationalpark (Côte d'Ivoire). *M. bellicosus* is an ecosystem engineer that plays a fundamental role in ecological processes such as plant decomposition, soil modifcation or the regulation of water availability.

Termite mounds in the savanna were monitored at the regional (transects: sampling points every 500 m for a total length of ~ 50 km) and a local scale (within one hectar) between 1992 to 2001. At the local scale, high fluctuations in mound density and colony turn over rates were recorded. Within one year all mounds/colonies of a patch can die, regardless of colony size. Army ants seem to be the driving force behind this pattern. They roam over large areas killing more or less all mounds. This was also reflected at the regional scale where the pattern of inhabited areas changed quickly. For the recruitment of young colonies regular rainfalls at the beginning of the rainy season seem to be the decisive factor. The annual nuptial flights of *M. bellicosus* take place after the first intensive rain (> 20 mm). Often thereafter a long period of drought occurs and the newly founded colonies die. At the local scale competition between colonies seem to regulate distribution patterns. Dead plant material after the annual fires is a limiting resource and young colonies can rarely establish in the close neighbourhood of large colonies.

So, the population structure of *M. bellicosus* in the Comoé Nationalpark can be described as a mosaic of highly dynamic patches in which densities fluctuate greatly within short periods. The dynamics are mainly driving by stochastic events such as army ant raids and rainfall patterns. However, at the local patch scale, intraspecific competition plays a role. These results imply that - like in rain forests - stochasticity is of profound importance in the large scale regulation of savannas, while competition can play a role in small scale processes.

Are Amazonian rainforests really poor in epiphytes? - It's just a question of scale

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Montane rainforests of the Neotropics are generally considered to harbour the maximum of the world's vascular epiphyte diversity. In contrast, preliminary data from Neotropical lowland sites suggest that lowland rainforests especially in the supposedly homogenous Amazon basin are very poor in epiphytes. To test this hypothesis, we expanded the data base of so far exclusively Northern Amazonian studies with data from Western Amazonia.

Field work was carried out at Tiputini Biodiversity Station (TBS, 0°38' S 76°09' W, 230 m a.s.l., 650 ha), situated in immediate vicinity to the Yasuní National Park in the Ecuadorian Amazon. Firstly, the epiphyte flora of the entire TBS was representatively inventoried. Secondly, the community of vascular epiphytes within a plot of 0.1 ha was surveyed. The spatial position and size of each individual plant was determined as well as further ecological and morphological features (e.g. branch diameter, substrate, number of flowers and fruits). The inventories for the entire TBS and the 0.1 ha plot were compared to other published Neotropical epiphyte inventories.

Our preliminary checklist for the complete area of the TBS includes 313 species, which is among the highest numbers for a Neotropical lowland site. Within the 0.1 ha plot, 9670 epiphytic individuals of 146 species and 24 families were found. Compared to other Neotropical 0.1 ha plots, individual and species numbers are the highest recorded so far and exceed even figures reported from Andean sites. Nevertheless, on the national scale of Ecuador epiphyte diversity peaks in lower montane rainforests of the Andes between 1000 and 1500 m a.s.l.

In conclusion, the epiphyte flora of Western Amazonian Tiputini shows an unexpectedly high alpha diversity and abundance. Thus, vascular epiphytes are not necessarily less abundant and diverse in Amazonian than in Andean forests. Factors promoting high epiphyte diversity at different spatial scales are discussed. Furthermore, our results suggest that Western Amazonian forests play a crucial role in conservation of Amazonian plant diversity.

Geographic range size and the explanation of spatial diversity patterns of New World palms

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Searching for general explanations of large-scale diversity patterns, conventional macroecological approaches focus on correlations between species richness and environmental predictors. Here, we investigate the effect of range size in these types of analyses using distribution data for all 550 native palm species of the Americas. We evaluate the contribution of range-restricted and widespread species to patterns of species richness and endemism and analyze the impact of range size differences on the predictive value of commonly used predictor variables (e.g. latitude, rainfall, net primary productivity, evapotranspiration,habitat heterogeneity). According to the size of their geographic range, species sequences were produced in ascending, descending, and random order. Sequential correlations between cumulative species richness patterns and environmental predictors were performed. Despite the higher proportion of species with relatively small geographic ranges, species richness patterns are dominated by the ~20% widespread species which contain 80% of the geographic distribution records. Climatic factors related to energy and water availability account for much of the spatial variation of species richness of widespread species but are much poorer predictors for range-restricted species. In contrast, species richness of range-restricted species is to a larger extent determined by topographical complexity. The predominance of widespread species highlights the difficulties to approximate causal explanations for the majority of species with small geographic ranges. We consider the effects of range size as crucial for a broader understanding of macroecological patterns and processes.

Local-scale diversity patterns of vascular epiphytes along an elevational gradient in the Andes

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We studied hypsometric changes in total vascular epiphyte diversity in tropical mountains based on inventories of 90 plots of 400 m² each sampled between 300-4000 m in 14 elevations in the eastern slopes of the Andes, Bolivia. Species richness was calculated separately for each canopy tree, for each 400 m² plot, and for the sum of four plots at a given site. About 800 species of epiphytes in 30 families and ca. 131 genera, were recorded and very high alpha-diversity values were obtained (up to 83 species in a single tree). Orchids were the most important family in terms of species number, followed by ferns. Especially in the mid-elevation plots, fern diversity relative to orchids, however, was much higher than recorded elsewhere. Aroids, bromeliads, piperoids, and other groups usually contributed less than 10% each per plot, except for the aroids, which had values of about 30 % at lower elevations.

A mid-elevation peak postulated previously for vascular epiphyte diversity was confirmed. Species numbers per tree, plot, and four plots showed a hump-shaped diversity distribution with maximum species numbers recorded at 1300 m. Analyzing the species richness of individual epiphyte groups by elevation, Bromeliaceae, Orchidaceae, Pteridophyta, and other families paralleled the overall bulging pattern, while aroids showed a steady decrease with increasing elevation.

Evaluation and future prospects of soil degradation in the Santa Cruz region, East Bolivia

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The eastern Bolivian lowland still encompasses large areas of relatively undisturbed tropical deciduous forest. In recent years the region east of the city of Santa Cruz has become one of the most important cultivation zones in Bolivia. Forest clearing accelerated basically due to the expansion of large farm soybean production. More than 11.000 km^2 of the natural vegetation in the study area were cleared over the 17-year period investigated (1984 – 2001). The annual deforestation rate increased from 0.6 % in 1992 up to 1.6 % in 2001. Most of the soils are highly fertile (alluvial deposits) and suitable for agriculture, but the application of inappropriate land and soil management practices has resulted in soil degradation processes like soil compaction, soil organic matter losses and nutrient decline.

Our study focuses on the assessment of soil degradation forms such as nutrient decline and soil compaction caused by different cropping systems, as well as the susceptibility to wind erosion, which is a serious problem in this region. We therefore applied geo-statistical approaches and developed several decision criteria to perform a spatial analysis by means of GIS. Several steps were performed to produce regular spaced continuous data layers.

First, we analyzed several Landsat images to obtain information about current and former land uses (e.g. permanent cropping or conversion into pasture...) and the applied cultivation system (e.g. large scale mechanized cropping, slash and burn systems...). A digital relief analysis using complex DTM attributes (SRTM-DTM, 90 m spatial resolution) has provided continuous terrain attributes. Climate variables were spatially predicted using a General Circulation Model (GCM) statistical downscaling approach which is based on empirical transfer functions that describe the observed local climate. The calculated climate and terrain variables were combined for parameterization of complex soil related process variables (e.g. wetness index...). An appropriate soil database was assembled and homogenized by using data of numerous local profile descriptions. Finally, specific soil variables (e.g. texture, organic matter content...) were regionalized by geo-statistically interpolation methods using terrain attributes and process parameter as predictor variables.

The subsequent spatial prognosis of soil degradation is still in process. In this context trends of the applied cultivation system regarding different soil degradation processes were derived from single local soil studies and used as decision criteria.

Tropical cyanobacteria under extreme and highly fluctuating conditions

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Terrestrial cyanobacteria are globally distributed and are found in microhabitats as various as open rock formations, on trunks and on leaf surfaces of higher plants. Even though there are no quantitative estimates of the total area covered by cyanobacteria, they undoubtedly play an important role in the net primary production and nitrogen input of tropical ecosystems. Here we present an actual review how cyanobacteria adapt to extreme and highly fluctuating climatic conditions, and interact with adjacent environment at rock habitats of the Guyana shield. Included are new results from analyses of UV-absorbing pigments, carotenoids, chlorophyll a fluorescence, as well as element and stable isotope ratios of nitrogen and carbon.

An interdisciplinary Workshop on Biodiversity: Systematics, Statistics, Informatics, GIS & applied field methods

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A workshop was hold at Kasetsart University in Bangkok/Thailand from Feb. 23 – Mar 3, 2004 to elucidate the complexity of Biodiversity in theory and practise. Practical investigations of tree composition and diversity were done in Doi Suthep-National Park (Chiang Mai). Three elevational zones are present: dry deciduous dipterocarp forest (up to 800 m); transition zone of semi-evergreen mid-elevation forest (800-1200 m); evergreen highland forest (1200-1680 m). To determine the 'minimum area', an inventory of all trees (at 500 m) was made at sites of different size, starting with 25m², doubling the area four times up to 400 m². Three more plots (400 m²) within the elevational gradient situated in dry dipterocarp forest (700 m) and in the transition between mid-elevation and highland forest (1200 and 1400 m) were analyzed. Samples of all tree species found were collected, compared and determined. Similarities were found between the two lower plots and between the two higher plots, whereas few tree species were shared between both groups. The respective plots were geo-referenced with a GIS. Finally the location of all trees in their respective plot were mapped with ArcView software and directly linked to the determinations and images of the respective trees. The workshop was supported by: Cooperative Research Network (CRN), Commission of Higher Education, Ministry of Education of Thailand.

Sustainable Farming in the Amazon - is that possible?

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Exploration of the oilfields in the Amazon rainforest basin of Ecuador has been accompanied by spontaneus colonization by people from the coast and the montainous andean region. The new arrivals usually have a different agro-cultural background from local ecological conditions and little knowledge about the ecological conditions for farming in the Amazon rainforest. Responsibility for sustainable agricultural education and research among the new colonists has the Instituto Nacional de Investigaciones Agropecuarias (INIAP - National Ecuadorian Agricultural Research Institute).

In cooperation with INIAP, the water and nutrient flux in four agroforestry systems (coffee, cacao, oilpalm and pasture) were compared with that in the primary forest (1997-1999). Electronic weather stations were used to measure and calculate the water flow. Litter-fall traps and bulk collectors were used to measure the nutrient input and nutrient losses were estimated through suction cups (for losses by percolation water) and estimations of crop yields.

The results showed a non-sustainable balance for some bioelements for pasture (Ca^{2+} und Mg^{2+}) and oilpalm (Mg^{2+}) and a sustainable balance for all investigated bioelements (N, P, K^{+}, Ca^{2+}, Mg^{2+} and S) for coffee and cacao. Therefore sustainable farming in the amazon depends in part on the particular agroforestry system.

Pteridophytes of the *Purdiaea nutans* forest in the Reserva Biologica San Francisco, southern Ecuador

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The Reserva Biologica San Francisco (ECSF) at the northern border of the Podocarpus National Park in southern Ecuador is a biodiversity hot spot. Most mentionable is the *Purdiaea nutans* forest, an unusual upper montane forest dominated by this otherwise very rare tree species (see also Mandl et al., this conference). In the framework of a DFG-supported project (FOR 402-A4) on the biogeography and ecology of the *Purdiaea nutans* forest, a list of all pteridophytes that occur in the *Purdiaea* forest has been compiled. A total of 113 species were found; most species-rich were the genera *Elaphoglossum* (19 spp.) and *Hymenophyllum s. l.* (13 spp.). Species new to science were found in the genera *Blechnum* (1 sp.), *Polystichum* (1 sp.), *Cyathea* (3 spp.), and *Elaphoglossum* (2 spp.)

The *Purdiaea nutans* forest occurs mainly on ridges and upper slopes, and always on very poor soils. Epiphytes of the families Grammitidaceae, Hymenophyllaceae, and Lomariopsidaceae form the major part of the fern flora; they often also grow terrestrially. Of obligatory terrestrial taxa only *Cyathea peladensis* (Hieron.) Domin and *Blechnum schomburgkii* (Klotzsch) C. Chr. are frequent. Within the study area, most typically terrestrial families (Thelypteridaceae, Aspleniaceae, Dryopteridaceae) are restricted to ravines and the lower slopes where nutrients are accumulated.

The biogeographical analysis demonstrated the role of the research area as a zone of contact and exchange of species. Noteworthy is the presence of *Pterozonium brevifrons* (A.C. Sm.) Lellinger, member of a genus that is most diverse in the Guyana Highland and having a distribution that coincides with that of *Purdiaea nutans*. Most pteridophytes belong to a Pan-Andean or northern Andean element; at least 4 species are endemic to Ecuador. Elements typical of the Tumbesian region or of the Central and Southern Andes are scarce.

Selected common genera are being tested for the presence of mycorrhizal fungi. Our first results indicate the prevalence of ascomycetes in epiphytic genera, both in phylogenetically basal (*Hymenophyllum*) and advanced ones (*Elaphoglossum*; Grammitidaceae), and of glomeromycetes (forming vascular-arbuscular mycorrhiza) in the few terrestrial species (*Cyathea*, *Blechnum*).

Small scale spatial distribution of ground herbs in three 1-ha plots in the Bolivian Andeas

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The interrelation between the distribution of ground herbs and environmental variables were investigated in three forest types (deciduous, semi-deciduous and evergreen) at the biological station Los Volcanes in Bolivia. In each forest type, a 1-ha plot with 25 20 x 20 m subunits was established and the species compostion, richness, abundance and the environmental properties were detected for each subunit.

Species composition and environmental conditions differed between subunits and forest types, the subunits from the deciduous forest type and the evergreen forest type showed the highest differences.

A canonical correspondence and a multiple regression analysis indicated that within and among plots the species distribution of ground herbs was significantly correlated to topography, soil-properties and tree cover.

Reproductive Seasonality in Relation to Climate and Fruit Availability in Wild Moustached Tamarins (*Saguinus mystax*, Callitrichidae, Primates).

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Neotropical primates of the genus *Saguinus* in the wild show an annual birth peak of 2-3 months duration, which generally occurs in the early half of the rainy season, and usually coincides with the annual period of maximum fruit abundance. However, data on climate, fruit abundance and reproduction have rarely been gathered simultaneously and systematically at the same population / location so that the actual interaction of these factors remains obscure. We present data on precipitation, fruit availability and reproductive seasonality in a total of six groups of wild moustached tamarins (*S. mystax*) collected at the Estación Biológica Quebrada Blanco (EBQB), Peru. From January to December 2001, precipitation was measured daily with the help of a rain gauge and summed up for each month. Fruit availability was measured monthly by checking a number of approximately 200 trees from 113 species dispersed over the study area for fruits and categorizing them on a scale from 0 (no fruits) to 3 (many fruits). Reproductive phases of two breeding females from two groups were determined measuring progestogen- and oestrogen metabolites in faecal samples collected on average twice a week. Distribution of births was determined in a total of six different groups through monthly censuses from January 2001 to September 2004. In 2001, the dry season (monthly precipitation < 200 mm) lasted from June to September. Fruit availability peaked in October at the beginning of the wet season and was lowest in the dry season. Hormonal profiles of the breeding females revealed three different reproductive phases: a 2-months period of post-partum ovarian inactivity, a 3- to 4-months phase of ovarian activity and 5 months of gestation. Conception in both females occurred at the end of the dry season so that gestation fell in the phase of maximum fruit availability. Dates of parturition were available for 16 births. They occurred from September to May, and thus covered the end of the dry season and the complete rainy season. Our data show that the energetically most costly phases of gestation (and lactation) predominantly fall in the rainy season when fruit availability is highest. Thus the reproductive phases of wild moustached tamarins appear to be well adapted to the season and therefore to fruit availability.

Terrestrial bryophyte diversity in montane ridge forest of southern Ecuador

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Montane ridge habitats in southern Ecuador are typically characterized by nutrient-poor acidic soils on underground of crystalline rock, with high precipitation and strong winds. The resulting vegetation is an open forest composed by low-statured trees. A noteworthy ridge forest type in the area is the *Purdiaea* forest, occurring exclusively in the Reserva Biologica San Francisco (ECSF) at the northern border of Podocarpus National Park (Lehnert et al., this conference) and being dominated by the rare treelet *Purdiaea nutans* (Clethraceae). The main objective of this study was to describe and understand the nature of the *Purdiaea* forest and its position within the altitudinal zonation schema of vegetation, through analysis of its terrestrial and epiphytic bryophyte vegetation and abiotic factors. For comparison' sake, two further ridge forests in the area were included in the study. They were similar in forest structure but differed somewhat in abiotic factors and virtual absence of *Purdiaea nutans*.

We sampled the diversity of terrestrial bryophytes in about fifty relevees of 500 cm^2 each. Recorded parameters included floristic composition, species richness and species abundance. In addition, we analysed soil and macroclimate characteristics at each site. Species richness in the three study sites was rather similar, but species composition was very different, with only few widespread species being shared by all three sites. Liverworts were the dominant group at each site, accounting for about 65-80 % of all the species. Members of Dicranaceae and Sphagnaceae (mosses) were common and characteristic in open places, Aneuraceae, Calypogeiaceae and Lepidoziaceae (liverworts) in more shaded ones. Shaded places were much richer in species than open ones. The terrestrial habitat appeared to be very heterogeneous in terms in terms of bryophyte diversity, due presumably to the rather open forest structure, with species composition and richness varying greatly between relevees. The study leads to the conclusion that the *Purdiaea* forest represents an azonal forest type unique to southern Ecuador. Its unusual species composition is probably due to a combination of abiotic factors including the unusually high precipitation (over 4000 mm), very acid soils (pH ca. 3.0), strong winds, and the special geomorphology of the area.

Seed dispersal by birds in Coastal Ecuador

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The speed of plant succession in human-dominated and disturbed land is often slow. This may be due to the loss of fruit-eating animals, which are important agents for seed dispersal. Coffee agroforestry can support high shade-tree diversity and, therefore, often may resemble near-natural rainforest. We investigated the diversity of birds and their importance as seed dispersal agents by sampling faeces. As coffee agroforestry differed in management strategies, we studied four different land-use types: complex shade coffee (high tree diversity), simple shade coffee (low tree diversity), abandoned coffee and intervened forest fragments. We used visual fixed radius point counts and sound equipment to estimate bird diversity. Further, we collected faecal samples of birds over a ten minute interval on vegetation and leaf litter at each point count. Faecal samples were dried and seeds were identified to morphospecies. We collected a total of 49767 seeds including 58 species potentially dispersed by 49 recorded fruit feeding bird species. The number of dispersed seed species was closely related to land-use type with more seeds dispersed in abandoned coffee than in the other investigated sites. Furthermore, seed diversity increased with increasing bird diversity. Our result show that shade complexity and lower land-use intensity may encourage succession through seed dispersal by birds. We conclude that multi-layered canopy and high tree diversity are important factors in maintaining higher bird diversity and ecological functions such as seed dispersal and forest regeneration. Abandoned coffee sites may function as conservation corridors enhancing forest recovery in a landscape with few natural forest fragments remained.

Validity of pedotransfer functions in two microcatchments of a tropical moutain rainforest in Southern Ecuador

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Water retention curves and hydraulic conductivity functions are essential soil parameters to describe water fluxes in soils. Direct measurements are possible, but go to great expense for larger scale studies. Thus, estimation methods are required. Unfortunately, these so called pedotransfer functions (PTFs) should be validated for each application area. Therefore two PTFs are investigated in the research area of the Estación Científica San Francisco (ECSF) in the Podocarpus National Park, Province Zamora-Chinchipe, Ecuador in order to test the applicability and validity for two catchments.

The first PTF, ROSETTA, is based on neural network analyses combined with the bootstrap method, predicting saturated condcutivities as well as the parameters of the van Genuchten equation describing water retention values and unsaturated conductivities. The second approach by RAWLS & BRAKENSIECK estimates BROOKS & COREY parameters by non-linear regression analysis and converts these values into VAN GENUCHTEN parameters. Input parameters for both PTFs are particle size distribution, bulk density and organic matter.

In each of the two catchments five profiles are selected, that cover the whole range of hydraulic soil properties. Laboratory measurements are carried out to determine texture, bulk density, water retention curves and hydraulic conductivity functions.

For the evaluation of the PTFs a direct and functional approach are used. The direct comparison will quantify accuracy by mean error, correlation coefficient and root mean square error. The process-based approach will be carried out by simulating water fluxes with Hydrus-1D using measured and predicted soil hydraulic properties as input data sets and a typical wheather data set. By this indirect comparison the ability of these material functions to describe the hydrologic system is evaluated, and thus the revelance.

In this contribution the principles of methodology and results will be presented.

Analysis of secondary mountain rain forests reveals different routes of forest regeneration depending on the mode of disturbance.

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The valley of the Rio San Francisco is deeply incised in the eastern range of the South Ecuadorian Andes between the Province Capitals Loja and Zamora. While the southern slopes of the valley are densely forested, the northern slopes have been cleared by slash and recurrent burning and are used for agriculture and pasture. Especially in the steep Quebradas, and surrounded by pasture-land, small islets of regenerating forest were found which show typical characters of a secondary forest. In the forests of the southern slopes similar patches of secondary forest were documented whose age by archive photographs turned out to be 50 years and less. In these areas fire was not used for clearing of the forest. The situation in the San Francisco valley allows a comparison of the various kinds of secondary forest, which are all situated at the same altitude of about 2000 m, with the original primary forest described by Bussmann (2002). While a minimum area was reported for the primary forest, such parameter could not be established in the patches of the secondary forest which nowhere exhibited a homogeneous vegetation. Floristic and structural analysis of these forests showed substantial differences in the structure and species composition between the secondary and the primary forests, but also differences between the secondary forests of different age and, surprisingly also differences between equal aged secondary forests regenerating after fire and those coming up after clear felling. The results show that in an area with an extraordinarily high dynamics (landslides) and regenerative potential of the forest, regeneration follows different patterns depending on the original mode of disturbance.

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Developing sustainable land and water management for the Aral Sea Basin through an interdisciplinary approach

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This paper discusses the environmental, social and economic aspects of the Aral Sea crisis, and describes a proposal designed to overcome the problem of unsustainable land and water use in the region. The Aral Sea has lost >60% of its surface compared to 1960, due to increased water diversion in irrigation systems. The production of cotton in huge irrigation systems has brought about water misuse and land degradation, and due to the tough economic transformation process faced by the central Asian countries, the region is characterized by increasing poverty.

Therefore, international development efforts today concentrate on improving ecological sustainability and economic efficiency of natural resource use in the region, as a contribution to combating poverty and desertification in the Basin, rather than on saving the Aral Sea as such.

The Center for Development Research (ZEF) at the University of Bonn, together with its partners, has set up a research program aimed at providing options for a restructuring of land and water use that are based on sound, long-term, interdisciplinary integration of different disciplines of science, and that are aiming at strengthening local institutional and individual capacity building. The various elements of this program and first results are presented, and the steps undertaken towards integration of the results of the different research areas are outlined.

Tracing successional patterns in mangrove forest - a case study

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The identification of successional patterns in mangrove forests is made difficult by scarcity or absence of historical data, which document former extensions and species distribution. We show, by means of satellite images as well as botanical and sedimentological studies, the development of mangrove stands in the Caeté estuary in equatorial Brazil between 1967 and today. Satellite images of the 1967's mission of the US American Corona Satellite were compared with Landsat scenes taken between 1986 and 2001 and Ikonos images of 2003. Tree density, species distribution and size were measured along a 380×10 m transect plot; soil samples were taken for salinity, organic content and pore water analyses. Sediment accretion reduced the width of a tidal side channel of Furo Branco from >100 m to a small stream. Ikonos imagery and ground checks revealed that the newly formed mud flats are dominated by Avicennia germinans trees, while Rhizophora mangle is the prevalent species in the surrounding areas. The size distribution of A. germinans shows that smaller trees are found towards the recently emerged parts of the former channel bed. Salinity and relative altitude (i.e., inundation frequency) vary only little along the transect. Decreasing density and larger individual size of A. germinans trees towards older parts of the forest suggest a succession from a pure A. germinans formation on a newly formed mud bank to a R. mangle dominated forest with remaining old A. germinans trees. Thus, mangrove tree zonation at Furo Branco is the result of successional changes and represents transitory rather than permanent patterns of plant distribution. Salinity and relative altitude, often cited in mangrove literature as determining factors for species distribution and zonation, are of no importance in this area.

Population dynamics of two sympatric mouse lemurs (*Microcebus murinus* and *M. ravelobensis*) in north-western Madagascar

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Closely related species with similar morphology and ecology may suffer from interspecific competition when sharing their habitat in a contact zone. This scenario may lead to the long-term exclusion of one competitor. Stable co-existence on the other hand is possible if resources are effectively partitioned or if the habitat is heterogenous. The aim of this study is to analyse the stability of co-existence of two sympatric sibling species of mouse lemurs in Ampijoroa, north-western Madagascar. Both species did not differ in body mass. The population dynamic was investigated by analysing monthly mark-recapture data obtained during nine dry seasons (Mai-October) from 1995-2003 in a study area of 30 ha. 564 individuals have repeatedly been trapped in 11453 installed traps. These were 334 *M. murinus* and 230 *M. ravelobensis*. Based on the capture data, the relative representation of both species in the traps, monthly population sizes and seasonal coefficients of association were calculated. Capture results revealed a *murinus*-biased species ratio during the first five years which shifted in favour of *M. ravelobensis* during the last four years. The monthly population size was estimated with the Jolly-Seber method and ranged from 25 to 59 for *M. murinus* and from <10-58 for *M. ravelobensis*. Within the first four years, the population size of *M. murinus* increased followed by a decline over the last five years. The population size of *M. ravelobensis* increased sharply until 1998 and continued to grow moderately during the last four years. The interspecific coefficients of association (Dice-index) of both mouse lemur species ranged from 0,23 to 0,51 in the non-reproductive period (Mai-July) and from 0,40 to 0,53 during the reproductive period (August-October), indicating the lack of spatial exclusion and a high degree of spatial overlap between both species. The results of this study indicate a dynamic situation with a potential increase of *M. ravelobensis* and a decline of *M. murinus* over nine years favouring interspecific competition or changes in the supply of species-specific resources as an explanation.

Dynamics of soil respiration along an elevation gradient in a montane tropical undisturbed forest in southern Ecuador

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Dynamics of soil carbon and influencing parameters in tropical ecosystems are not sufficiently investigated in order to understand soil carbon cycling and sequestration, as well as to evaluate their importance for climate change scenarios. Therefore, this study aimed at improving the understanding of source-sink-dynamics of carbon in soils of tropical montane rain forests

Total soil respiration (TSR) and soil temperature (Ts) were measured bi-weekly from July 2003 to November 2004 on five plots between 1100 and 3100 m a.s.l. using a closed dynamic chamber system (EGM 4, PP Systems) fitted with a temperature sensor. In addition we monitored volumetric water content (VWC) in the organic layer and in 10 cm mineral soil. In total, TSR ranged between 0.01 and 2.47 g CO_2 m^{-2} h^{-1} and decreased distinctly with increasing altitude. As expected, TSR increased with higher Ts. VWC ranged between 4 and 60 % and was negatively correlated with TSR.

Measurement of diurnal CO_2 flux was carried out once on three plots at 1100 m, 2000 m and 3100 m a.s.l. and revealed no clear daily pattern. Calculated annual fluxes ranged between 4.18 Mg C ha^{-1} a^{-1} at 3100 m and 16.2 Mg C ha^{-1} a^{-1} and therefore amongst the highest worldwide. Furthermore, we separated heterotrophic and root respiration in a trenching experiment at 1850 m, which started in January 2004. TSR on this plot normally varied between 0.2 and 0.8 g CO_2 m^{-2} h^{-1} and only after about 230 days that followed the trenching, TSR was consistently above respiration of the trenched plot. According to our preliminary results, the contribution of roots to TSR ranged between 17 and 40 %. In comparison to the results of various studies this percentage is rather low, which may be explained by dead roots, that are not yet fully decomposed and that are thereby enhancing food supply for decomposers. This would then result in higher activity, and respiration, of the heterotrophic microorganisms. For verification of this assumption monitoring of TSR and heterotrophic respiration will be continued.

Key words: soil respiration, heterotrophic respiration, root respiration, montane tropical forest, Ecuador

Selecting the drought stressed: Effects of plant stress on intraspecific and intraindividual herbivory patterns of leaf-cutting ants

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Leaf-cutting ants (LCA) are dominant herbivores of neotropical rainforests. They are highly polyphagous but at the same time highly selective. While a broad range of leaf properties has been identified to influence the choice of a given plant species, the question of how both intraspecific and intraindividual variability in leaf features influence herbivory patterns remain obscure. Here, we evaluate the plant stress hypothesis by analyzing whether drought stress of food plants positively affects LCA host plant selection. Drought stress in the tropics has received growing attention in the last years, not least because of its increasing relevance in fragmented and disturbed habitats, where LCA occur in high densities. Published data about the effects of leaf water content on host plant selection of LCA are scarce and inconsistent.

We showed, by means of bioassays, that drought stressed plants and plant parts are attractive to workers of the LCA *Atta colombica*. In experiments with whole, potted plants of *Piper marginatum,* the leaf area harvested of stressed plants was doubled compared to vigorous control plants. This difference was due to selective recruitment, since fragment size and cutting velocity, which could also increase harvest rates, were not affected. Within an individual plant the attractiveness of a leaf increased with its stress level. We could demonstrate that this preference was caused by an increase of osmolyte concentrations in the stressed plants. In leaves of stressed plants, proline and non-structural carbohydrates have been shown to increase by a factor of 3.5 and 2, respectively. Moreover, samples taken from preferred leaves contained more osmolytes than those representing the whole plant. Additional bioassays using leaf-disks with experimentally increased concentrations of proline and sugar indicated that LCA did in fact respond to the presence of these compounds.

Our results support the plant stress hypothesis, confirming that stressed plants are more attractive to herbivores. Such host plant selection by LCA may influence populations of host species through the discrimination of drought-sensitive individuals. On the other hand, this preference for stressed plants may explain why LCA populations benefit from disturbed habitats like forest fragments and edges where plants are known to be more prone to drought stress.

Trophobioses between ants and hemipterans in a tropical rainforest in Borneo

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Ants are the most dominant group of arthropods in tropical rain forests. For many ant colonies, honeydew (excretion from plant-sucking hemipterans) is a crucial ressource that is commonly monopolised against competing ant species. Our study was carried out in a rainforest in Borneo, Malaysia. We found 57 ant species (18 genera) that were associated with 45 species of hemipterans on 39 plant species from 22 families. *Camponotus*, *Crematogaster* and *Dolichoderus* were the most common ant genera. The most frequent host plant in the forest understorey was the climbing bamboo *Dinochloa trichogona* (Poaceae), on which two groups of ant-attended hemipterans, Delphacidae and Coreidae, were found exclusively; both infested 26% the bamboo individuals examined. In open secondary vegetation, the common invasive weed *Eupatorium odoratum* (Asteraceae) harboured ant-attended gall-forming aphids (infestation rate: 83%). Most common trophobioses were attended by a broad spectrum of ants at the local scale, although trophobioses on each plant individual were often restricted to a single ant colony per time (in 95% of all surveys). Although many ant species were opportunistic in their choices of hemipterans and plants, overall partitioning between associated ant, homopteran, and plant partners was significant.

Most ant species attended their hemipterans day and night, but in some cases there was a change of guards between diurnal *Polyrhachis* and nocturnal *Camponotus*.

We placed sugar baits near the trophobiosis to test whether additional sugar-feeding ants occurred in the vicinity. One bait was placed next to the trophobiosis, a second bait on a different branch of the same plant and a third one on a neighbouring plant. In most cases (73%), baits next to the trophobiosis were only visited by the same ant involved in the trophobiosis. Ant species number and diversity increased significantly with distance to the trophobiosis, indicating a possible effect of competitive exclusion by the dominant ant that effectively monopolised the honeydew source and its surrounding.

Food and time – niche ecology of a sand dune reptile community

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The reptile community of an intermediate sand dune habitat between hamada and erg in the Jbil National Park, southern Tunisia has been studied. Investigations of activity patterns, behaviour and foraging modes result in narrow time frames for each species, in which the animals search for food and/or mates. Other than that, the animals shelter from overheating and predator pressure or for hibernation by burrowing or using burrows of other animals. Results of stomach samples and observations divide the reptile community into different trophic levels: consumers of second and higher orders. Regarding members of the same trophic level, niches are separated by different activity patterns.

The surface of this habitat is almost completely covered by sand, accumulated to small dunes of max. 2 m height, often with *Aristida pungens* grasses on top, whereas *Oudneya africana* shrubs grow on thinner sand layers. These plants seem to provide most of the energy input of the system. Even though fresh phytomass is potentially available, the food web is based on detritus consumption by Lepismatidae (Insecta: Thysanura) and Tenebrionidae (Insecta: Coleoptera). Ten reptile species occur permanently, of which *Acanthodactylus dumerili*, *A. scutellatus*, *Scincus scincus*, *Trapelus tournevillei* and *Varanus griseus* are diurnal, *Cerastes vipera*, *Lytorhynchus diadema*, *Stenodactylus petrii*, *Tarentola neglecta* and *Sphenops boulengeri* are nocturnal. Three further species are occasional visitors: *Psammophis schokari* and *Acanthodactylus longipes* (diurnal) and *Cerastes cerastes* (nocturnal).

Although generalists, the study of stomach samples show differences in prey and/or food selection of these reptiles. Food web analysis results in various predator-prey-interactions, therefore the separation in trophic levels was based on the priority of food intake. To proof these results, $^{15}N/^{14}N$ analysis are currently running for tissue, plant and detritus samples.

Land use effects on insect diversity on *Passiflora edulis* in coastal Ecuador

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A mosaic of agroecosystems characterizes tropical landscapes. Natural forest and shaded coffee agroforestry systems are typically recognised as refuges of biodiversity in these fragmented habitats. We compared the richness of these habitats with other less diverse land-use systems like rice and pasture.

We investigated the diversity of insects on *Passiflora edulis* (Maracuja) in different land-use types in a megadiverse region in coastal Ecuador. The land-use types form a gradient of land-use intensity comprising near-natural forest, abandoned coffee, shaded coffee (agroforestry), pasture and rice. In total, 30 sample plots were studied (six samples for each land-use type). In each sample plot, 14 *Passiflora* plants were planted. We collected insects following the beating technique, knocking every plant until no further insects fall onto the beating sheet. Afterwards the specimens were counted and identified to orders and families (or genera) and sorted to morphospecies.

We found a total of 2957 individuals belonging to 267 morphoespecies on a total leaf area surface of 135 m^2 in all 30 land-use systems. For each sample plot, we calculated the number of species and individuals per unit of surface (m^2). We found that forest had significantly more species than abandoned coffee, shaded coffee and rice. In contrast to our expectations, the second most diverse land-use type was pasture. Coffee and pasture were the land-use systems with the highest number of individuals. Rice was the poorest land-use type, both in terms of diversity and abundance.

Confirming the results of other authors, our investigation indicates that land-use could have a large influence upon the diversity of communities' insects, with a clear trend of decreasing diversity with increasing land-use intensity. However, we stress that man-made landscapes like pasture and coffee plantations may have a surprisingly great potential for conservation.

Diversity patterns of epiphytic lichens and bryophytes along a gradient of human disturbance in montane rain forest in southern Ecuador

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Epiphytic bryophytes and lichens contribute considerably to total biomass in tropical montane rain forests, show high species richness, and play an important role in ecosystem functioning. During the last decades these habitats, especially those of the northern Andes, are increasingly affected by human activities, resulting in loss of forest at an alarming rate. Little is known about the impact of the deforestation on the diversity of the cryptogamic plants, however. Within the framework of the multidisciplinary DFG-project "Funcionality in a tropical mountain forest: diversity, dynamic processes and use-potential under ecosystems aspects" we studied the epiphytic lichen and bryophyte flora in primary and disturbed montane rain forest, and on isolated trees in southern Ecuador. Main objectives were to compare diversity patterns of these habitat types and determine the value of cryptogamic plants as indicators of disturbance. Thirty trees in more than one thousand relevées were sampled, from the tree base to the outer parts of the crown. In addition, microclimate factors were measured. More than two hundred species (112 genera, 59 families) were recorded. Diversity and percentage cover of bryophytes is significantly reduced with increased forest disturbance whereas lichen diversity and percentage cover is significantlly higher on isolated trees than in primary forest. Shade epiphytes and species with a specific life form strategy (e.g. wefts, pendants) are most negatively affected by forest disturbance. The observed species patterns are correlated with changes in environmental parameters along the gradient of anthropogenic disturbance. Project financed by the DFG (GR 1588/5; FOR 402/1)

Re-thinking Gap Analysis – a new approach to an old methodology

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Gap analyses, worldwide, have become a common methodology and tool for conservation planning identifying areas where additional protected areas might be required for the protection of rare or endangered elements of biodiversity. Most of those analyses focus on the representation of certain species (fine filter), landscapes or vegetation types (coarse filter) within certain areas. Often, it is neglected if the biological systems to be represented within protected areas are still functional and viable in the long run. Among other problems, the results tend to be too static and do not take into account the ongoing changes of the ecosystems due to natural or anthropogenic driving forces such as climate change or land use changes. Thus, a new approach is presented considering those dynamics in order to maintain the functionality of ecosystems rather than focusing on single species representation in protected areas.

Under a functional conservation approach it has to be critically analyzed if the biological systems really require protection or if they adapt to the current anthropogenic pressures. In addition, it must be determined how these systems will react under the predicted scenarios. An important consideration is that a biologically distinct community or ecosystem does not automatically merit adequate representation within protected areas.

A case study of a national gap analysis in Bolivia is presented, using extrapolated species diversity patterns, socio-economic and demographic data as well as scenarios of climate and land use change. The conservation targets considered, focus on coarse filters elements (corridors facilitating altitudinal migration, population movements, range shifts, large blocks of intact forests, and sensitive forest areas) and elements derived from fine filter analyses (such as, areas of extraordinary evolutionary activity indicated by high values of endemism richness and unique biological communities with a restricted distribution).

It is claimed that many endangered and still viable species will survive when the conservation of functional landscape ecosystems is prioritized. A functional gap analysis, which considers global change-induced dynamics, provides new arguments for the answer to the SLOSS-question (Single Large Or Several Small protected areas) and even challenges the classical protected-area-based conservation.

Factors affecting malaria infection rate in New World primates

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Parasites are ubiquitous in free-ranging animals and affect host fitness, but very little is known about factors that influence the risk of infection and disease, and the effectiveness of behavioural defences to reduce this risk. We investigated the effect of group size, body mass and sleeping behaviour on of the prevalence of malaria infections in Neotropical primates with data obtained from the literature. Malaria is transmitted to these primates through nocturnally active anopheline mosquitoes that use olfactory cues to find their hosts. Comparative tests using phylogenetic corrections confirm that malaria prevalence increases with group size in Neotropical primates, as suggested by a previous non-phylogenetic analysis (Davies et al. 1991, Funct Ecol 5: 655-662). This is consistent with the hypothesis that larger groups experience increased risk of attack by mosquitoes, and contrasts with the hypothesis that increasing group size leads to reduced insect attacks through an encounter-dilution effect. Body mass was significant in few phylogeny-based analyses, primarily when group size was included as a covariate. We also tested the previous hypothesis (Heymann 2001, Folia Primatol 72:153) that sleeping in closed microhabitats (tree holes, tangles of vines) reduces the risk of malaria by containing the host cues used by mosquitoes to locate hosts. This hypothesis was supported partially. In summary, risk of infection with malaria is likely to act as a cost of group living in Neotropical primates, while sleeping site selection may provide a benefit by reducing rates of attack by malaria vectors.

Population structure and intraspecific agonism in the fungus-growing termite *Macrotermes bellicosus* (Isoptera, Macrotermitinae)

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Fungus growing termites are ecosystem engineers of African savannah ecosystems, however their population structures and underlying mechanisms are poorly understood. We studied the genetic population structure of the mound building fungus grower *Macrotermes bellicosus* which is a keytone species of West African savannah, using microsatellite markers. Additional behavioral studies on the occurrence of intraspecific agonism were done to reveal its importance for the structuring of populations. The genetic study was conducted with colonies from Comoé National Park, Ivory Coast, and from Pendjari National Park, Benin. The Comoé National Park mainly consists of guinea savannah and gallery forests along the Comoé river where samples were taken from both habitats, whereas savannah dominates in Pendjari National Park. *M. bellicosus* inhabits both, savannah and gallery forests, however it is restricted to clearings in the latter.

We collected 861 specimens, of which 311 where obtained from Pendjari National Park. First results revealed that within each population the genetic diversity was high and inbreeding was low. When comparing the populations, there was a small but significant genetic divergence between Ivory Coast and Benin (F_{ST} = 0.08). In addition, considerably lower genetic structuring was detected between the savannah and the gallery forest in Ivory Coast (F_{ST} = 0.016). We concluded that the higher genetic divergence between Ivory Coast and Benin is due to geographic distance, although there still is considerable gene flow between both populations. This reflects the contiunuous distribution of *M. bellicosus* and the lack of geographic or climatic barriers. The much lower genetic divergence between the gallery forest and the savannah in Ivory Coast might be explained by microclimatic differences in both habitats. These put an enormous adaptive behavioral and possibly physiological pressure on the termites. However, these differences reduce gene flow only to a very small amount.

For the intraspecific aggression study we used 24 colonies from Pendjari National Park. We performed 36 tests with partial colonies, 24 control (intracolonial) and 12 test (intercolonial) experiments, with a total of 8724 specimens. Individuals in test colonies had a significantly reduced survival . Separated by castes, small soldiers had a significantly reduced survival in test experiments. There was a similar trend for small workers and large soldiers. Therefore we conclude that there is antagonistic behavior between neighbouring *M. bellicosus* colonies and that the soldier caste plays a fundamental role in colony defense against conspecifics. Further analysis will show whether aggression is correlated with genetic distance.

Seasonality in an evergreen tropical mountain forest

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More than 400 individuals of 13 tree species growing in an evergreen tropical mountain rain forest in South Ecuador were examined over a period of 3 to 4 years with respect to flowering and fruiting as phenological events. Leaf shedding was followed over one year. In spite of the perhumid climate a high degree of synchronization was observed at the species level, but also groups of non-related species showed synchronized flowering and fructification. Except one species that flowered more or less continuously, two groups of trees could be observed, of which one flowered during the less humid months (starting September/October) while the second group started to produce their flowers towards the end of that phase and then flowered during the heavy rains (April to June). Casting of leaves, even of the evergreen trees, showed one or two favored phases in the course of a year. Concomitantly with the phenological recordings, climate was monitored in detail at both the regional and the local scale. No correlation of flowering and fruiting with seasonal changes in the amounts of precipitation could be found, but changes in cloudiness and especially in the ratio of direct to diffuse global radiation coincided with the induction of flowering of both groups. Superimposed to the periodical synchronization by the light regime were irregular events. Periods of unusual cold or dryness affected the incidence of flowering, fruit maturation and the production of germinable seeds. As Ecuador suffers the highest rate of deforestation in South America, reforestation has become a great issue, but the proper indigenous plant material is not yet available. Knowledge of the biology of reproduction is a prerequisite for raising seedlings of indigenous trees in the dimensions of tree nurseries.

Tree species distribution in Várzea forests of Brazilian Amazonia

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Floodplains of the Amazon which are inundated by nutrient-rich white-water rivers are called várzea. These occur all along the Amazon River and its main white-water tributaries. The forests growing in these floodplains are regularly flooded for up to 210 days per year by water columns of up to 10 m. Topographic variation results in different flooding amplitudes and durations along the flooding gradient, where the different tolerance to flooding of different plant species results in a vegetation zonation. We made a revision of literature about the vegetation composition of várzea floodplain forests of Brazilian Amazonia along the Amazon River. 22 studies were selected. Basing on the distribution of inventories which are concentrated in three main areas around three larger cities Belém, Manaus and Tefé, we classified the inventories into three regions:

Region A: Estuary region with flooding regime influenced by daily inundations linked to the tides.

Region B: Central Amazonia near Manaus.

Region C: Western part of Brazilian Amazonia bordering Peru and Colombia, including Tefé and the "Reserva de Desenvolvimento Sustentável Mamirauá".

Summarizing the analysed species lists, 36 species were registered in all sampled regions including the estuary. The region A + C have 63 species in common, region B + C 143, and A + B have 50 woody species in common. In the inventories analysed here, an increase of species numbers from East to West can be confirmed but it is difficult to state whether this is not an artefact due to local sampling. Vertical zonation patterns are difficult to discuss due to the lack of comparable data. The inventoried areas are small, and there is an urgent need for a comparable floristic inventories spread over the whole basin. Destruction is spreading rapidly and the traditional use of the forests and its resources is changing to a destructive exploitation which already has changed much of the physiognomy and diversity of this unique ecosystem.

Changes in land use patterns on Borneo (Malaysia): Ant communities (Formicidae) in oil palm (*Elaeis guineensis)* plantations – a biodiversity assessment

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Borneo is a major hot spot of arthropod biodiversity, and more than 630 species of ants are reported from Kinabalu National Park (www.antbase.de). However, over the last 30 years the conversion of primary forest into agricultural land has expanded rapidly. In 2000 about 1 Mio ha or ca. 15% of the total land area of Sabah were covered by plantations of the oil palm *Elaeis guineensis*, a native wetland species from West Africa, thus rising serious concerns that palm oil production may negatively affect biodiversity of local ecosystems. Establishment of oil palm plantations includes a complete clearing of the forested land and terracing of the ground, both leading to a complete change of the ecosystem. The high productivity of the monocultures is maintained by the use of fertilizer, herbicides and insecticides. Integrated pest management can massively reduce the necessity for insecticide application in oil palm plantations, while disposal of organic matter may help rebuilding the soil structure. Our ongoing project aims at monitoring the effects of these treatments and targets at an improvement of the ecological control of pest insects. It includes an investigation on the impact of oil palm cultivation on the natural fauna in Malaysia. As focus organisms we used ants that are well known bioindicators in land management elsewhere. Here we report on the biodiversity of the ant communities in an oil palm plantation in Sabah, East Malaysia.

Ant fauna was monitored in two large oil palm estates (1756 ha and 2575 ha), that were farmed with integrated pest management for over 10 years. We sampled the ant fauna of 661 palms from 13 fields belonging to three age classes from cut off palm fronds. Ground dwelling ants were collected by Barber-traps and at tuna baits.

Our results indicate an alarming loss of biodiversity in this agroforestry system. Only 13 (morpho-) species of Formicidae were found in the oil palm canopy. These included, e.g., the common *Oecophylla smaragdina*, as well as *Anoplolepis gracilipes*, a pantropic, invasive ant species. However, the ground ant fauna of the plantations comprised of much more species, and the insertion of organic matter into the soil may be a cost-effective way to maintain a higher biodiversity, as it is indicated by our preliminary results. Oil palm plantations seem to sustain only a very small part of Sabah's entire ant fauna, they provide a potential stepping stone for intrusion of invasive species and may act as an effective dispersal barrier. Dedicated conservation programs that combine the economic necessities of food production with ecological needs are required to sustain the living heritage of Malaysia's biodiversity in a time of economic growth.

Seed production, germination, and seedling growth of *Parkia pendula* (Willd.) Benth. ex Walp. (Mimosaceae) in a Mata Atlântica fragment in Pernambuco, Brazil: Differences between edge zone and forest interior

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Parkia pendula is a widespread canopy tree occurring in Neotropical lowland rainforests from south of Honduras to Northeast Brazil. It is one of the most common trees in Pernambucean Atlantic rainforest remnants. Currently, the reproduction of 16 adult individuals in the forest interior and 14 in the forest edge zone is being observed. As far as tree height, diameter at breast height and crown size are concerned, there are no significant differences between the trees of the two sites. In 2003, the *P. pendula* trees in the edge zone produced significantly more seeds than the trees in the interior. The number of seeds per 100 m² crown area increased from 14,092 (median) to 78,909 (median) from the interior to the edge, respectively (Mann-Whitney U=40.0; p=0.002). However, the germination conditions seem to be better in the forest interior. Only every 443rd (median) seed in the edge zone but every 176th (median) in the forest interior germinated until October (Mann-Whitney U=48.0; p=0.013). The total number of seedlings under the tree crowns differed only in the first month of observation significantly between the two sites (Mann-Whitney U=53.0; p=0.013). This difference disappeared from March on (Mann-Whitney U>74.5; p>0.120). Up to now, no differences were observed in the number of leaves as a measurement for seedling growth.

This system is a proof for Murcias (1995) theoretic considerations about edge effects. She stated that patterns of edge effects are not as simple as our simplistic view of edges. Processes at one level could neutralize edge effects at a different level. In this example the two opposed processes of seed production (higher in the edge zone) and the number of germinated seeds (higher in the interior) neutralizes edge effects at the level of total number of seedling under tree crowns.

Research 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.

Keywords: Brazil, edge effects, fragmentation, Mata Atlântica, *Parkia pendula*, seed dormancy, seedling growth, seedling survival, seed production

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Avifauna of the Southeastern Himalayan Region: New Birds and Need for Conservation

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Knowledge concerning the avifauna of Myanmar is critical concerning creation of understanding of the composition and dynamics of bird communities, and conservation of the avifauna of Southeast Asia and the Himalayas. Myanmar is an extraordinarily rich country in terms of biological diversity and species richness. The territory of the Union includes a remarkable diversity of habitats from arid plains to humid rainforest and alpine meadows. There remain few parts of the world where it is possible to find completely new species of vertebrates and plants in significant numbers, but the sub-Himalayan region of northern Myanmar is one such place. Work during the past decade on plants, mammals, and reptiles has demonstrated its richness, and recent expeditions into the region have discovered new bird taxa. These findings revolutionize understanding of the complex biogeography of this relatively unexplored area. In addition to this diversity of birds and habitats, Myanmar is also unique in terms of the amount of relatively pristine environments that remain in the country. Huge areas of forest and other primary habitats still serve as a source and unique reference for further research in conservation, biodiversity, and ecology. Nevertheless, significant human impact is visible in all areas. Identification of the components of diversity and development of conservation strategies are essential.

Abandoned coffee fields as a refuge of arthropod diversity and natural-enemy populations

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Traditional coffee agroforestry systems may support high numbers of shade tree species and a generally high biodiversity. Due to low coffee prices on the world market, many farmers abandon their farms. Therefore there is an increasing interest in the diversity of these "new" ecosystems. In our investigation we compared the arthropod community of managed coffee agroforestry with abandoned coffee. We studied the arthropods of coffee shrubs in six agroforestry and six abandoned sites in coastal Ecuador (June to October 2003, Manabi). The abandoned coffee sites were not managed for more than ten years. For collecting arthropods we used the insecticidal tree-fogging method with 0.1% pyrethrum. We investigated eight plants per site, six of them inside, two at the edge of the site. The arthropods were counted and identified to orders. All effects were calculated with a U-test of Mann and Whitney, which used abundance of orders as factor (in abandoned versus managed sites). Our results show great differences in the arthropod community structure. We found significantly more arthropod individuals in the abandoned coffee sites than in the agroforestry systems. Moreover there was a higher number of insect orders and a higher predator-prey ratio in the abandoned coffee sites. We therefore identified the abandoned coffee fields as an important ecosystem helping to maintain biodiversity and to enhance natural-enemy populations such as the antagonists of the coffee berry borer *Hypothemus hampei* (Ferrari) (Coleoptera: Scolytidae).

Repatriation of Knowledge about Insect Type Specimens through the DORSA Virtual Museum (Digital Orthoptera Specimen Access)

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Much of the type material documenting tropical insect diversity is deposited in European or North American museums. During a 3-year project we documented, using high-resolution photographs of different views/specimen, nearly 9,000 Orthoptera type specimens from nine collections in Germany. The resulting collection of 30,000 images is linked with the data-based original label information and available as a "Virtual Museum" through the SYSTAX database which is connected both to the 'Global Biodiversity Information Facility' (GBIF) and the 'Biological Collection Access Service for Europe' (BIOCASE) portals (for current links, see http://www.dorsa.de). Reciprocal links to the 'Orthoptera Species File' (OSF) connect DORSA to a validated taxonomic name register. OSF authority files allow comparisons between published type data (OSF) and our DORSA specimen data. We discovered discrepancies between published type data and museum specimens, such as missing type material (650 primary types) and undocumented types (39 primary types). Exact data about missing type specimens allow initiation of effective searches to fill these gaps by designating lectotypes, either from other collections or neotypes by searches at the type locality. The DORSA web-based repository provides sufficient detailed information, including diagnostic features (e.g. genitalia), to allow taxonomists to narrow down loan requests. Most type specimens in German collections were collected in tropical countries reflecting Germany's scientific expeditions and colonial history. Publishing type specimen data and images through a Virtual Museum signifies repatriation of knowledge for countries of type origin. In addition DORSA includes voucher specimens linked to respective sound records. Many of these specimens are hitherto undescribed species and can be considered as "types of tomorrow". We hope that our information platform will facilitate taxonomic research, especially in tropical countries. To this end we plan to provide access to original taxonomic descriptions, and increase the usability of DORSA with improved query and visualisation tools. DORSA was supported by the German Federal Ministry of Education and Research (BMBF).

Indigenous and scientific knowledge on soil quality indicators in Cabuyal watershed Cauca Colombia a comparative study.

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The present Paper is a contribution to validate the local knowledge about soil quality as basic source for the local community to make decisions, because it is peasants who have a permanent contact with their natural resources - in this case the soil- and thus to contribute to the local and sustainable planning of its resources.

The field study was put into effect in the river Cabuyal watershed Cauca Colombia, for this 3500 soil samples were taken and 47 farmers were interviewed. With the help of direct interviews, workshops and a survey. It compared and verified the improvement of the soil quality from both the scientists and the local peasants´ view. Our approach in defining soil quality and health indicators must be holistic, not reductionistic

The indicators of quality of the soil vary in their sensitivity. For that reason, to construct reliable indices, it is necessary that they serve as signal for monitoring and for predicting the effects of the culture systems, and the practices of handling in the productivity of the soil, environmental quality, nourishing security and quality of human health animal and plants

Within the study´s results, is observed the improvement of some chemical parameters of the soils (Carbon, Phosphorus, aluminum saturation,) through thirty years. The agriculturists affirm that their soils have improved in the last thirty years due to the introduction of practices of soil conservation, but first of all to protect the soil with permanent cultures as is in this case the associated culture of coffee with trees (Agroforestrysystem)

Biomassburning in the amazon as fertilizer for tropical mountain forest?

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Tropical mountain forests of southern Ecuador are ecosystems of extremely high biodiversity, due to their climatic conditions and scarceness of macro nutrients like phosphate and nitrate. The project PREDICT has studied water and nutrient input (major ions: Na^+, K^+, NH_4^+, Mg^{2+}, Ca^{2+}, Cl-, NO_3^-, SO_4^{2-} and PO_4^{3-}, pH, conductivity) by fog and rain in the last three years. Rainfall for this area is much higher than known and a significant amount is contributed to the hydrological cycle by fog-scavenging.

The project employs modern techniques like remote sensing (Radar, satellite imagery) and meteorological data. An altitudinal gradient of fog collection devices and rain water samplers provide information about vertical variations of water and nutrient input. The data are collected with high temporal resolution and on a long-term basis.

Rainfall distribution in the study area is highly dependent on orographic situation and exposition to the prevailing easterly tradewinds. Fog input is controlled by windspeed, cloudiness and topographic situations. Rainfall maximums of 6000 mm/year are exceeded in some parts and fog may contribute further 400 to 500 mm annually.

Nutrient input is generally low; neither a seasonal nor altitudinal variation is clearly detectable. However, several episodic events were observed, that brought high concentrations of sulfate and/or nitrate. By analysing backward trajectory (Flextra-model) the origin for these inputs could be determined. Emissions from volcanic eruptions (El Reventador 3.11.02, northern Ecuador) and intensive biomass burning in the amazon could be linked with observations of elevated ion concentrations, especially in fog and cloudwater.

Investigation of stable isotopes (sulfate: ^{32}S, ^{33}S, ^{34}S, ^{36}S , oxygen: ^{16}O, ^{17}O and ^{18}O, nitrate ^{16}O, ^{17}O , ^{18}O; additionally radioactive ^{35}S) will be used in the next phase, to produce further evidence of the link between climatological situation, emission events and the input registered in the study area. A continuous elevated nutrient input by emissions from forest fires and a declining water input due to reduced evapotranspiration in the amazon could alter the tropical mountain ecosystem. If the hypothesis can be confirmed, tropical mountain forest is susceptible to environmental changes on the local and regional scale and by this could serve as an indicator of ecologic conditions in tropical southamerica in general.

Methodology and some general results will be presented.

Modeling the regeneration of disturbed tropical montane cloud forest in Central Veracruz, Mexico.

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The area covered by tropical montane cloud forest (TMCF) in Central Veracruz has decreased rapidly during the last 50 years. Deforestation has been accompanied by the fragmentation of the remaining forest. Restoring the TMCF and the important ecological services it provides (e.g. capture of water from clouds, soil conservation) requires an understanding of the vegetation dynamics of this ecosystem. The objective of this study is to investigate the dynamics of old-growth forest and forest regeneration after abandoning pastures and coffee plantations. We apply a modified version of the process-based forest growth model FORMIND. FORMIND is individual-tree-oriented and simulates the spatio-temporal dynamics of an uneven-aged mixed forest stand. The modifications include (1) grouping tree species according to their light demands and maximum heights, (2) defining regeneration, growth and mortality parameters for each species group, and (3) developing allometric relations of tree geometry. We verify the model by comparing model outcomes and observed patterns (e.g. inventory data, diameter increment data). Results show that the model is able to reproduce the structure of old-growth forest. Simulations of forest regeneration reveal that the proportion of biomass of each species group reaches a steady state only after 300 years, although total biomass and stem numbers recover already after 80-90 years. The gained insights can support regional decision making in forest conservation and restoration planning.

Energy issues in Nepal Himalayas; an overview on its present status, problems and future

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This paper presents an overview on the present status of biomass energy in Nepal. Biomass is the main source of domestic energy, which includes fuelwood (81%), agricultural residues (4%) and animal dung (6%) and rest fossil fuels (9%). Only 12% of total population has access to electricity (4.5% of rural population and 89% of urban population). Energy consumption patterns indicate that the fuelwood is the main source of energy in residential sector. There has been a big gap between the sustainable fuelwood supply from accessible forests and the demand for fuelwood; 5.5 versus 11.5 million metric tonnes in 1994/95. Per capita energy consumption in Nepal is ranked as one of the lowest among the least developed countries. Forest available to rural people for basic needs have decreased from 0.55 ha/person in 1964 to 0.09 ha/person in 1998 and the forest area has decreased from 45% of the total in 1964 to 29% in 1998, i.e. the alarming deforestation rate of more than 2% per year. Reforestation compensates for only 9% of annual loss. The total final energy consumption in FY 1994/95 was estimated to be 260 million GT, 90% of which were consumed in household sectors. More than 87% of total commercial energy consumed is met through imports. The energy problem in Nepal arises not from excessive reliance on non-renewable energy resources, but rather from the fact that one form of energy (i.e. fuelwood) is being consumed at the unsustainable rate, while the vast potential of the other forms of renewable energy (such as hydroelectricity etc.) remains virtually unused. The much talked water resources are underlined and poorly managed, providing irrigation to only about 37% of total irritable land and generating 254 MW of electric power against the economic potential of about 45,000 MW.

This paper further compares the situation of Nepal with the other South Asian countries. Similar to Nepal, in most of the developing countries, woodfuels are mainly composed of fuelwood directly derived from forest and non-forest lands, especially in Asia and Africa. In developed countries great proportions of energy are obtained from black liquor and residues. High income countries consume more modern than traditional fuels. Therefore, wood energy consumption tends to be higher in lower income countries which is reflected in all the developing nations. Finally, this paper discusses on the future management strategies of sustainable energy in accordance with the Kyoto protocol.

Key-words: fuelwood, energy, woodfuels, renewable energy

Nutritional differences and leaf acclimation of climbing plants and the associated vegetation in different types of an Andean montane rainforest

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Climbing plants are known to play an increasing role in several tropical forest systems, but key features for their distribution are only partly understood. We tested if climbers differ from self supporting vegetation in their adaptability to adjust leaf parameters over a wide variety of light regimes in different forest types along an altitudinal gradient.

Leaf area index (LAI), canopy gap fraction (DIFN) and relative photon flux density (PFD_{rel}) were assessed above 75 pairs of strictly linked climbers and supporting vegetation on seven plots between 2020 m a.s.l. and 2700 m a.s.l. along a mountain range in South-Ecuador up to the Páramo vegetation. Leaf samples from both growth forms were analysed for leaf area (LA), specific leaf mass (LMA), mass and area based carbon and nitrogen concentration (C, C_{area}, N, N_{area}), and concentrations of P, K, Ca, Mg, Mn, and Al.

Climbers built smaller leaves with lower LMA. Leaf size of climbers was independent upon general light condition, whereas the leaf size of the self-supporting vegetation increased in shade. N, P and K were higher concentrated in the leaves of climbers than in their supporters. Relationships of LMA and N_{area} to the light conditions were more pronounced within the climbers than within their supporters. Slope for the regression between climber's N_{area} and LMA or C_{area}, respectively, was twice as steep as for the supporter leaves. A steeper slope of the K/LMA relationship within the climber leaves supports the trade-off between low structural investment and osmotic adjustment. Al accumulators were only found within the self-supporting vegetation.

The investigated traits indicate improved adjustment toward light within climbers compared to self supporting vegetation. Low structural investment combined with enhanced nutritional status in leaves of the climbing growth form can result in strong competitive ability, as long as the nutrient supply can cover the higher demand of the climbers.

Dormancy-breaking in *Bunium persicum* seeds by stratification and some phytohormones

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Bunium persicum (Boiss.) B. Fedtsch. (or *Carum persicum*) is a grassy plant belong to umbelifera with dormant seeds that is not cultivate but grows wildly on the mountains of Iran. It has been described several therapeutic effects including those on digestive disorders, urinary tract disorders, diuretic gynaecologic, anti-convulsion, anti-helmetic and also anti-asthma and dyspnea for the seeds of *B. persicum* in Iranian ancient medical books. Because of these pharmaceutical effects, termination of dormancy for cultivation of these seeds is important. The study of phenology of *Bunium persicum* showed that the seeds germinated in spring and required exposure to cold temperature before germination. Also previous studies showed that some concentration of plant growth regulators overcome seed dormancy in this plant. In this research, the effect of seed storage, cold stratification with or without above plant growth regulators in dormancy breaking of these seeds was investigated. In this work effect of stratification and storage on dormancy breaking and induction of germination and combined effects of hormonal treatments, storage and stratification on breakage of seed dormancy were determined. The treatments were arranged as factorial Design and the data were analyzed and statistically compared using on Complete Randomized Design with three replications. To identify effect of stratification on seed dormancy, the seeds stored for 0, 2, 4, 6, 8 or 10 weeks at 4°C in refrigerator and then transfer to germinator set. Results showed that stratification is require for dormancy breaking in *Bunium persicum* seeds and increasing the duration of stratification increased germination. Also, combining stratification and phytohormones promoted germination.

KEYWORDS: *SEED GERMINATION,* BUNIUM PERSICUM, *STRATIFICATION,* DORMANCY-BREAKING, GIBBERELLIC ACID, KINETN

Incipient speciation and gradual adaptation to different pollinators in Andean *Echinopsis ancistrophora* (Cactaceae)

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The South American Andes of Bolivia and northern Argentina are home to the second-largest diversity of Cactaceae. However, due to the enormous variability of many of these plants, the delineation of taxa is highly problematic. Likely reasons are ongoing speciation processes. The *Echinopsis ancistrophora* group is one such taxonomically difficult entity. Remarkably, in these plants the floral traits and their combinations vary between populations, with highly variable flower length, color, scent, anthesis time and nectar production. This group provides excellent conditions for gaining insight in the mechanisms responsible for Andean cactus diversity, to study the role of pollinator attraction in speciation, and to better understand the delineations of pollination syndromes.

First efforts to construct a molecular phylogeny of this group suggest a polytomy of 11 white-flowering populations from NW Argentina - on which we focus here - nested within lineages with mostly colorful flowers. While variation within these populations is little, differences between them are remarkable: medium flower length varies between 5 and 24 cm, mean nectar quantities range from 0 to 170 μl, anthesis is in the evening, at night or in the morning. Both nectar quantity and anthesis time are correlated with flower length. Our ongoing analyses of floral scent indicate no significant differences between white-flowering populations, but correlation with flower color. Evidence for pollination by sphingids was only found in few populations in which the combination of floral traits fits in the concept of hawkmoth pollination syndrome. In all other white-flowering populations - with flower length from 5 to 16 cm and little or no nectar, anthesis beginning in the morning or late at night - pollination was by solitary bees. Several of those populations have flower types not fitting in the classic understanding of neither the hawkmoth nor the bee syndrome, and may reflect transitional stages. Our findings suggest incipient speciation, presumably by separation and subsequent selection through flower visitation. Survival of transitional populations is guaranteed by bees, being more flexible foragers than sphingids.

An updated checklist of the vascular plants of Burkina Faso

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For more than 15 years there is a close cooperation between the Senckenberg Research Institute, the University of Frankfurt and the University of Ouagadougou, first within the framework of the interdisciplinary research project 268, now since 2001 in the course of the BIOTA project. In the last years, the collections of the Herbarium Senckenbergianum (FR) and especially the Ouagadougou University Herbarium (OUA) grew through massive collecting activities, adding a lot of new species to the ones already known from the checklist of Lebrun from 1991. Most of these specimens are already databased and thus form the base for a first draft of our checklist (~ 1,400 spp.). By visualizing the geographic distribution of collections and combining this information with climate and topography, key areas for focussed collecting were identified. A first 3-week collecting expedition to SW Burkina revealed already 40 species new to the country's flora. After satisfactory coverage of all key collecting areas the final draft of the checklist will be completed. Such a comrehensive checklist is felt to be of urgent need for research and conservation and can form the starting point of a national flora project.

Forest Soils on the SW-Slopes of Mount Kilimanjaro

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The formation of the East African Rift Valley was accompanied by volcanic activity which created large volcanoes such as Mt. Kilimanjaro. While the lower slopes of Mt. Kilimanjaro are used for agriculture, mountain rainforests still cover the area between 1800 and 3100m at the southern slopes. According to a classification by Hemp (2002), the forest belt can be divided into an Agauria-Ocotea forest (1800-2000 m), an Ocotea-Podocarpus forest (2100-2300 m), a Podocarpus-Ocotea forest (2400-2700 m) and an Erica excelsa or Hagenia-Rapanea forest which gradually changes to shrublands at elevations above 3000 m. Highest rainfall amounts were observed at around 2100m in this region. The soils developed mainly from layered volcanic ashes. In a transect study along the Machame tourist trail at the southwestern slopes, soils at 1850, 2090, 2265, 2530, 2700, 2900, 3100 and 3150 m were described, classified and chemically characterised.

All soils were classified as sil-andic Andisols with Hapludands at lower elevations, Placaquands at around 2300 m, Melanudands at 2500 m, followed by Fulvudands and Haplustands with increasing elevation. The highest profile was classified as Endoaquand. Hydromorphic features were mainly observed between 2300 and 2500m and at the highest profile, where impermeable bedrock below 0.5m from the soil surface led to water stagnation. Up to five buried soils were found in the profiles. Very dark fossil A horizons were most pronounced at mid elevations. The soils exhibited typical properties derived from volcanic ash such as high contents of amorphous clays, low bulk densities and a high accumulation of organic carbon and nitrogen. Positive ΔpH values and high Si_o contents indicated that profiles at lower elevations had on average higher contents of variable charge clays than at higher elevations. As all soils were acidic with very low ECEC values, they were considered to be already in an advanced stage of weathering and leaching. The exchange sites were mainly occupied by Al, resulting in a low base saturation and very low overall contents of exchangeable nutrient cations in the mineral soil. The low cation retention capacity of the soils indicates that any disturbance to the forest will lead to leaching losses of released cationic nutrients.

Hemp, A. (2002): Ecology of the pteridophytes on the southern slopes of Mt. Kilimanjaro. I. Altitudinal distribtution. *Plant Ecology* 159, 211-239.

Relation between nutrient fluxes and plant species richness in a tropical montane rainforest of Bolivia

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In tropical montane rainforests deposition and decomposition of litter is one of the major pathways for nutrients, which are accumulated in the organic layer. We have studied litter input und turnover rates in the organic layer in relation to species richness of six vascular plant groups (ferns, melastoms, aroids, bromeliads, palms, cacti) in a mature, undisturbed rainforest in the eastern Andes of Bolivia between 1700 and 3400 m a.s.l. Annual fine litter amounts were measured at the altitudes of 1900 m, 2600 m and 3050 m, while organic layers and vegetation distribution were analysed at elevational intervals of 100 m. Nutrient turnover in the organic layer was estimated by relating the nutrient amount (N, P, S, K, Mg, Ca, Al, Fe, Mn, Zn) of annual litter fall with nutrient storage in the Oi- horizon of the organic layer. Correlation between vegetation distribution and nutrient parameters of the organic layer were analyzed using principal component analysis and multiple regression.

Species richness was highest between 1700m and 2100m and decreased with increasing elevation. Input of annual fine litter was 12.2 t ha^{-1} yr^{-1} in the Lower Montane Forest (LMF), 5.3 t ha^{-1} yr^{-1} in Upper Montane Cloud Forest (UMCF), and 4.7 t ha^{-1} yr^{-1} in the Subalpine Cloud Forest (SCF). The nutrient stocks in the organic layer of the upper vegetation zones (UMCF, SCF) were similar or larger than in LMF due to the higher accumulation of organic material with increasing elevation. In comparison to other tropical montane rainforests plant nutrient stock was high in all vegetation units. N, P and S stocks from litterfall were reduced most strongly between LMF and SCF. Turnover rates (k_{oi}) of N, S and P were significant reduced between LMF and UMCF. Comparisons between plant species diversity and nutrient parameters of the organic layer along the elevational gradient in the study area demonstrated a significant correlation between the "mineralization factor" (C/N, C/S, C/P) in the O-Horizon with changes in plant species diversity along the gradient.

We suggest that plant species richness decreased with increasing elevation due to reduced availability of N, P and S at higher elevation, which in turn was caused by reduced mineralisation rates as a consequence of increased soil waterlogging and decreasing temperatures with increasing elevation.

Forest biodiversity conservation by the *Mro* tribe in Chittagong Hill Tracts in Bangladesh: The present national policy and practice

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Traditionally, indigenous communities worldwide are knowledgeable about their surrounding natural resources on which they are intimately dependent. The Chittagong Hill Tracts (CHTs) region is rich in natural dense forests with comparatively higher biodiversity in Bangladesh. The *Mro,* one of the Indigenous groups living in CHTs in Bangladesh have developed their livelihood inside the high ranges of hills and dense forest. They are severely dependent on the surrounding natural forests for their foods, fruits, medicines and retaining their culture unique. The lifestyle and ethno-forestry perception governing the daily activities of the ethnic communities need to be explored highly, in order to conserve them as well as to assess the possibilities to conserve the forest biodiversity by utilizing such traditional indigenous concepts as well as to receive the intellectual property rights. But most of the wealth of indigenous knowledge of the tribal people in CHTs is being threatened by the settlements of the non-tribal people in the region. The study to explore the forest dependence of the *Mro* tribe was conducted in three arenas, i.e., the housing pattern and food habit; healthcare practice; and shifting cultivation practice. The study shows a particular pattern of housing status and food habit of the *Mro* community in Bangladesh. The phenomena observed in the study area correspond to the severe dependence on their surrounding biodiversity in the forestlands for their fooding, medicare and housing and the dimension of dependency reflected their ethno-botanical knowledge. Shifting cultivation by them showed some important indigenous knowledge of retaining soil fertility and agricultural practices. The whole livelihood of the *Mro* was found friendly to the biodiversity conservation in the forests. The study also reviews the existing biodiversity conservation policy of the Government and the practice. The indigenous knowledge developed by the *Mro* tribe for forest utilization can be used as a tool for the conservation of forest biodiversity by coinciding with the perception of the Convention on Biological Diversity (CBD).

Inter- and intra-specific sharing of incubation mounds by megapodes: brood parasitism or communal nesting?

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Use of mounds by more than one species of megapode (Aves: Megapodiidae) has been assumed to be brood parasitism. In a study of three sympatric megapode species in Papua New Guinea (Wattled Brush-Turkeys *Aepypodius arfakianus*, Brown-collared Talegallas *Talegalla jobiensis* and New Guinea Megapodes *Megapodius decollatus*), I observed behaviours that have been hypothesised to increase susceptibility to parasitism and be precursors to birds becoming brood parasites. Talegallas renovate abandoned mounds of the other two species and use mounds concurrently with NG Megapodes, while contributing to maintenance of the mound. NG Megapodes do not defend their mounds and more than one pair share some mounds, with all pairs contributing to maintenance. There was no inter-specific use of Brush-turkey mounds, where the male builds, maintains, and defends the mound, with females visiting only to copulate and lay. In describing megapodes as brood parasites, little attention has been given to similarities these observations have with communal and colonial nesting. None of the hypothesized costs to hosts from parasitism appear to apply to NG Megapodes and Talegallas. Unlike typical brood parasitism, sharing of mounds may benefit 'host' megapodes through more efficient incubation and shared parental care (maintenance of the mound), and lower predation risk due to the dilution effect of extra eggs in shared mounds. Inter-and intra-specific sharing of mounds by megapodes appears to more closely resemble a special case of communal nesting than it does brood parasitism.

How many lichen species grow on a single tree? Observations in primary tropical forests compared

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Tree inventories in 6 tropical primary forest areas (Montfoort & Ek 1990 in lowland rain forest in French Guiana; Aptroot 1997 in humid mountain forest in New Guinea; Welz 2000 in semideciduous lowland forest in El Salvador; Komposch & Hafellner 2000 in lowland forest in Venezuela; Holz 2003 in mountain oak forest in Costa Rica ; Nöske (in prep.) in humid mountain forest in Ecuador) show that individual trees house surprizingly high numbers of lichen species, far more than in temperate forests. The figures from the studies vary greatly, with mean values between 33 lichen species per tree (31 trees) and c. 140 (2 trees). This suggests variations in species richness of the investigated forest types. However, reexamination of one of the areas with a different method suggests that the observed differences are probably more dependent on observation procedures and experience of the observer.

The influence of altitude on plant nutrition in a tropical montane forest in Southern Ecuador

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The availability of minerall nutrients for plants is influenced by soil and plant properties. Soil chemical and microbial parameters have a great impact on nutrient concentration in soil solution. Fine root length density and nutrient uptake ability per unit root length are plant characteristics that are important for nutrient acquisition. Nutrient availability in tropical montane forests is often very low. An increase in altitude in tropical montane forests is accompanied by a change in environmental conditions. E.g., temperatures decrease while soil water contents increase. These changes cause a reduction of litter decomposition and nutrient mineralization. To assess the influence of altitude on the nutrient status of the native vegetation various chemical soil parameters and morphological and physiological root parameters were measured at three different sites (1860 m, 2380 m and 3060 m abovesealevel) of a tropical montane forest in the South of Ecuador. Soil pH values were generally very low ranging between 2.3 and 3.7 in the forest floor. The N_{min} pools decreased from 13 kg N/ha at 1860 m to 6.3 and 6.8 kgN/ha at 2380 m and 3060 m, respectively. The depth of the forest floor increased from 15 cm at the lower altitudes to 30 cm at 3000 m. The special importance of the forest floor for nutrient acquisition at high elevations was reflected by the close correlation between the spatial distribution of N_{min} pools and fine roots. The percentage of total fine root length that was located in the forest floor increased with altitude from 51 % at 1860 m to 61 % and 76 % at 2380 m and 3060 m, respectively. The N-uptake ability was estimated by ^{15}N uptake studies. The N uptake ability per unit fine root length was similar in all soil horizons and did not change with soil depth. Therefore, it may be expected that N uptake from different soil horizons is closely reflected by the distribution of fine root length. The fine root length density was sufficient to assure access to most N_{min} also in mineral soil. C/N-ratios of fine roots and leaves increased with increasing altitude. E.g. fine roots with a diameter > 1 mm had C/N ratios of 33 at 1890 m, 42 at 2380 m and 53 at 3060 m. The results confirm the assumption that N-availability is generally very low in this ecosystem and further decreases with increasing altitude. Therefore, N limitation may be one cause for low formation of above-ground biomass at high elevations. Analysis of the contents of other plant available nutrients in soil and the mineral composition of leaves may give further information about elements limiting plant growth in this montane forest.

Is leaf variegation in *Caladium steudneriaefolium* (Araceae) serving as mimicry?

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The leaves of *Caladium steudneriaefolium* Engler, an Araceae of the understorey of submontane forest in the Podocarpus National Park (South Ecuador, 1000 m a.s.l.), are uniformly green or patterned with whitish variegation. Of the 3413 individual leaves randomly chosen and checked (April 2003), two thirds were uniformly green, whereas one third were variegated (i.e., whitish due to absence of chloroplasts). Leaves of both morphs are frequently attacked by mining caterpillars of an unidentified species of moth. It was observed that the variegated leaf zones strongly resemble recent damages caused by mining larvae, and therefore mimick a moth attack. The rate of infestation by moth larvae for both leaf types was checked and found to differ considerably: Infestation of green leaves was 18.75 times higher than of variegated leaves. Obviously, the egg-depositing moths are deterred by the miner infestation mimicry, which might be of high benefit for the plants despite the implicated loss of photosynthetically active surface.

To test this hypothesis, an experiment with three groups of 200 individuals each of *Caladium.steudneriaefolium* was established (March 2004). Group 1 was represented by plants with green leaves, group 2 with variegated leaves, and group 3 with green leaves that were painted with white correction fluid (PASSOLA) in a pattern mimicking the natural variegation. After two and four months the number of leaves attacked by moth larvae in each group was counted. Both, group 2 (variegated leaves) and group 3 (manipulated leaves), were found to be significantly less infested than group 1 (green leaves). On the average 4.4 % of group 1 were attacked by the mining moth, whereas moth larvae were found only on 0.6 % of the leaves of group 2 and 0.5 % of group 3. Thus, the hypothesis that leaf variegation in *C. steudneriaefolium* reduces the likelihood of attacks by leaf-mining. moths is supported.

The use of sensory cues for foraging by two sympatric Neotropical gleaning bats

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The majority of insectivorous leaf-nosed bats (Phyllostomidae) are gleaners. Their prey is close to or on surfaces and consequently difficult to detect for an echolocation bat as echoes from prey and background often overlap. Gleaners thus frequently use additional sensorial cues for foraging. We investigated the role of different sensorial cues for prey detection and localization in two representatives of the functional group of gleaning insectivores, Micronycteris hirsuta and Tonatia saurophila (Phyllostomidae). In behavioural experiments in a flight cage we offered the bats katydids that produced sound, such as wingbeat, landing sounds on dry leaves and communication calls. We also offered silent (stationary) katydids on different surfaces, and recorded all capture attempts of the bats. If mainly echolocation was used for prey detection and localization, silent and sound-producing insects should be taken in equal proportions. We performed all experiments under red light as well as in complete darkness to test for the role of vision. In addition, we presented plastic dummies to the bats to determine the role of shape, texture and olfaction.

Both species reacted reacted almost exlusively only to flight noises of katydids. Landing sounds elicited a reaction from the bats to a lesser extent. Only M. hirsuta took silent stationary prey. Performance of bats was not affected by presence or absence of light. Only one individual of T. saurophila, but several M. hirsuta attempted to "capture" a prey dummy. Both species proved to be mainly perch-hunters. However, M. hirsuta also actively searched for prey by slowly flying along the walls and floor of the flight cage.

We suggest that both species use mainly prey produced sounds for detection and localization of prey and echolocation for orientation in space. This is supported by an earlier study of the echolocating behaviour of these species. However, M. hirsuta might use echolocation to some extent also for foraging. Differences in foraging strategy combined with different sensorial adaptations may lead to perceptual differences in prey availability within the same habitat and contribute to resource partitioning and niche separation for the two species.

The importance of species interactions and ecological traits for regional distribution pattern of dragonflies in arid Namibia

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Freshwaters can be classified into types with respect to the extent of drying they experience. While temporary waters limit the distribution of taxa due to harsh physical conditions (drying), perennial waters limit distribution of taxa through biotic factors. Hence, species occurring in different types of freshwaters along the gradient should differ in ecological traits, e.g. behaviour and life history. In arid Namibia perennial as well as temporary waters are present and all are colonised by up to 25 species of dragonflies per locality. Three groups of dragonflies can be distinguished: (1) species entering the area only after the seasonal rainfalls and ovipositing in all kinds of freshwaters (obligate migrants), (2) species occurring in all types of freshwaters, and (3) species occurring exclusively in perennial waters. Species of the two latter groups are present in the desert all over the year, i.e. are residents in the desert.

It is hypothesised that species of the three groups should differ in behavioural and life history traits of larvae. For the studies species of the family Libellulidae were selected, which are the most common African dragonflies. Comparing two species each of groups (1) and (2) it was found that the previous (the migrants) grow faster and behave more active than the latter. In a second study pairs of species belonging to three genera of dragonflies were compared, with one species of each genus belongs to group (2) the other to group (3). Significant differences in growth rates between the habitat-groups were recorded, whereas activity was only affected by the generic relationship of the species. We concluded that particularly growth rate determines the habitat selection of a species.

Field observations let to the hypothesis that the community patterns are also influenced by species interactions. We tested the hypothesis that intraguild predation and priority effects influence the outcome of such interaction between a migrant (group 1) and a resident of group (2). The population of the resident only survived when it has temporal advantage over the migrant, leading to the conclusion that the migrant should particularly dominate habitats, which are formed directly after the rains, whereas the residents should dominate longer existing habitats. The distribution patterns of Odonata in Namibia are discussed in the light of these finding.

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Hitchhikers on bats: Flower mites travel on bats between inflorescences of *Calyptrogyne ghiesbreghtiana* (Arecaceae)

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We present the association between a new species of flower mite (tribe Melicharini) and neotropical flower-visiting bats. Analogous to the well-known hummingbird – mite interactions these mites use bat visitors to inflorescences of the lowland tropical palm *Calyptrogyne ghiesbreghtiana* as a means to travel to new inflorescences. Flower mites were found to occupy 76 % of all active inflorescences surveyed. However, newly opened inflorescences were mite-free. In spite of a Tanglefoot® barrier on the peduncle that prevented colonization by walking animals, numerous mites appeared on these "crawling-exclusion" inflorescences within a few days, indicating they had arrived by air. Visitors to the *Calyptrogyne* inflorescences were caught with mistnets near the plants. While *Calyptrogyne* received visits from both hovering Glossophagines (*Glossophaga commissarisi, Hylonycteris underwoodi*) and perching Stenodermatines (*Artibeus watsoni / phaeotis*) as well as Carolliines (*Carollia brevicauda*), only the latter were found to carry mites, indicating that the fast visits of hovering glossophagine bats (< 1 s) might not allow mites to mount the bats. In contrast, *Artibeus* spec. that occasionally perched for several minutes carried up to 19 mites per individual, mainly on the wings. Phenology data show a tight coupling between the occurrence of mites on bats and flowering phenology of *C. ghiesbreghtiana*, suggesting that the palm is the most important host for the mites.

Ecology of the Trumpet-Nosed Bat *Musonycteris harrisoni*, a specialized flower-visitor from the endangered dry forests of Western Mexico

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We studied the ecology of the Trumpet-Nosed Bat *Musonycteris harrisoni* (Phyllostomidae: Glossophaginae), a rare nectar-feeding bat endemic to Western Mexico characterized by an extraordinarily long snout, and explored potential reasons for the morphological cranial specialization.

Study site was in the state of Colima, W-Mexico. Between July 2002 and March 2004 we captured bats on 82 evenings during three field periods covering both the rainy and thedry season, mainly in small banana plantations adjacent to natural "selva baja caducifolia" vegetation. We took basic morphological measurements of each bat and collected pollen from its pelage and faecal samples to assess floral resource use. Infra-red video was used for additional observations of bats visiting flowers.

Three species of nectar-feeding bats were resident in the study area (*M. harrisoni, G. soricina, L. curasoae*), the fourth species *A. geoffroyi* was only caught during the wet season, a period of low flower availability in the natural vegetation. We captured 28 *M. harrisoni* in the wet and 30 in the dry season. This represents the largest data set in existence for this species. Dietary analysis revealed various species of Cactacteae and Bombacaceae, and the genera *Helicteres* (Sterculiaceae), *Crataeva, Cleome* (Capparidaceae) and *Agave* (Agavaceae) as important components of the diet. We found no indication for a tight relationship between *M. harrisoni* and particularly long-tubed flowers that would obligatory require a long rostrum for exploitation. However, cacti seem to play a particular important role for the species, as revealed by pollen load and direct observations. The tongue of *M. harrisoni* may reach at least 85 mm into flowers and might aid in efficient nectar extraction from the large cactus flowers. Nectar was the main diet throughout the entire year, use of alternative food sources was extremely low, even in times of flower scarceness. Interestingly, we found a significant sexual dimorphism in rostrum length. Males had significantly longer snouts (ca. 9 %) than females, suggesting that the enormously long snout is not necessarily shaped by direct foraging requirements alone, but perhaps also influenced by –so far unknown – intraspecific interactions.

Spatial scale and land-use affect additively partitioned diversity of trap-nesting Hymenoptera S.

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With the decline in global biodiversity and the concomitant loss of potentially important ecosystem services, an understanding of the factors that govern species richness and the spatial scales over which these factors operate, has become one of the most pressing issues facing ecologists today. For the first time we tested the effect of spatial scale on α, β and γ diversity in the tropics using trap-nesting bees and wasps (Hymenoptera: Aculeata) in southwest Ecuador, a "biodiversity hotspot". Hymenoptera are particularly salient from an ecosystem services perspective, as many species are important pollinators of natural vegetation and agricultural crops and others are natural enemies of many herbivore taxa. We examined diversity within five land-use types that comprised a gradient of decreasing agricultural intensity from rice and pasture to coffee agroforests, abandoned agroforests and forest fragments.

Land-use significantly affected α diversity of trap-nesting Hymenoptera at the subplot scale, but not β diversity or plot-scale species richness (γ diversity). Floral diversity was positively correlated with diversity of Hymenoptera at the subplot scale, but not at the plot scale. Conversely, distance to the nearest forest fragment only affected diversity at the plot scale, and not at the subplot scale. Surprisingly, diversity increased significantly with increasing distance to forest fragments, indicating that these environments do not necessarily serve as source populations for trap-nesting Hymenoptera. This study showed a high importance of spatial turnover, which is expected in the tropics, but turnover was surprisingly higher between plots within a land-use type than between land-use types. We emphasize caution in the estimation of biodiversity at only one spatial scale and highlight the large contribution of managed land to overall biodiversity.

Do flowering plants make nectar-feeding vertebrates live on the fast track of life?

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The relationship between metabolism of mammals and their diet has provoked intense discussion (e.g. McNab 1969, Elgar and Harvey 1987, Speakman & Thomas 2001). However, all current studies are based on metadata analysis of basal metabolic rates and thus far no one has focused on field metabolic rates of free-ranging animals and its relationship to diet. Field metabolic rates are measured over 24-hour periods and reflect the animals' realized metabolic rates within the ecological context, whereas basal metabolic rates equal the minimum power requirements of living in resting and post-absorptive condition measured in the animals' thermoneutral zones in the laboratory. In the present study, we measured the field metabolic rates of two phytophagous bats using the doubly-labelled water method. Both species, 9 g nectar-feeding *Glossophaga commissarisi* (n=10) and 18 g fruit-eating *Carollia brevicauda* (n=12; both Phyllostomidae), occupied the same daytime roosts in a Costa Rican rainforest. Although the two species differed in body mass by a factor of two, the average field metabolic rate was not significantly different. The overall mean field metabolic rate equalled 48.1 ± 8.4 kJ d^{-1} (± 1 SD). We estimated that nectar-feeding *G. commissarisi* have to visit approximately 1200 flowers, whereas *C. brevicauda* need to forage only on a few *Piper* fruits to meet their daily energy requirements. In addition to more foraging flights, nectarivorous bats also have to perform more exploratory flights than frugivorous bats in search for food as food resources are less predictable for nectar-feeding than for fruit-eating bats. Taken together, different selective forces of plants act on pollinators and fruit dispersers respectively. This may result in diet-specific field metabolic rates. A more comprehensive literature review shows that within vertebrate taxa nectar-feeding members have a higher field metabolic rate than non-nectar-feeding members. A comparison of field metabolic rate between nectar-feeding members of different vertebrate taxa demonstrates that 9 g *G. commissarisi* have twice the metabolic rate of a 9 g nectar-feeding possum, but only half the metabolic rate of a 9 g hummingbird. Thus, regarding energy turnover aerial nectar-feeders top terrestrial nectar-feeders and among aerial nectar-feeding vertebrates, hummingbirds top bats. We argue that within all vertebrate taxa, plants are the main selective that push the field metabolic rate of their pollinators to high sustained levels. High field metabolic rates, on the other hand, may select for elevated basal metabolic rates owing to the physiological necessity for larger muscles and organs.

From forest to farmland: habitat effects on Afrotropical forest bird diversity

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Although the Guinea-Congolian rainforest region is an important focal point for conservation in Africa, very few information is available on the effects of forest modification and land use on the region's biodiversity. We studied bird communities and vegetation characteristics in 24 sampling stations distributed over two near-natural forests (near-primary forest, secondary forest), and two land use types (agroforestry, annual cultures) in the lowlands of the Korup region, Cameroon. Repeated sampling was used to establish near-complete inventories of bird assemblages for each site. Despite a 90% average drop in tree basal area from forest to farmland, overall bird species richness did not decrease significantly with increasing habitat modification. However, different groups of birds responded in different ways. Frugivorous and omnivorous birds' species richness did not differ between habitats, whereas richness in granivorous, flower-visiting, and non-breeding species was higher in land use systems compared to forests. In contrast, insectivorous birds, especially terrestrial and large arboreal foliage gleaning insectivores, and ant followers showed a declining species richness from forest to farmland. Also richness in species of those restricted to the Guinea-Congolian forest biome, and of the family Pycnonotidae showed a pronounced decline with increasing habitat modification. Species richness of overall insectivores, terrestrial insectivores, large- and medium-sized arboreal foliage gleaners, ant followers, as well as pycnonotids and biome-restricted species were strongly or even very strongly positively correlated with overstory tree density and in most cases also with basal area. In contrast, tree density and basal area were strongly negatively correlated with species richness of non-breeding visitors and flower-visiting bird species. Species composition was most distinct between near-primary forest and annual culture sites, and the abundance of 23 out of 165 species was affected by habitat, suggesting considerable partitioning of habitat niches along the habitat gradient. Our results stress the importance of tree cover in tropical land use systems for the maintenance of resident forest bird populations and confirm that natural forest management is more beneficial for global bird conservation compared to other forms of forest exploitation, including agroforestry systems.

Culture – Land Use – Biodiversity: Explaining the Cultural Driving Forces of Land Use Decisions at Rainforest Margins in Central Sulawesi, Indonesia

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Located within the region of Wallacea, the island of Sulawesi represents one of the world's most important hotspots of biodiversity. The Lore Lindu National Park plays a crucial role in the conservation of endemic fauna and flora, as it is one of only two larger protected forest areas in the province of Central Sulawesi. Like in other regions, however, this site is endangered by the impacts of human action. Besides encroachments of the protected forest areas, different land use patterns and practices may decrease or increase the degree of biodiversity at the rainforest margins. Therefore, this study aims to analyse the cultural driving forces that influence people's decisions on land use in three villages surrounding the Lore Lindu National Park.

This research is part of the collaborative research program SFB 552 – STORMA "Stability of Rainforest Margins", sponsored by the German Research Foundation (DFG). We conducted a quantitative census survey, comprising every household of the three villages, from April to September 2004 in order to filter factors like ethnic affiliation, migration, education, knowledge, skills, social networking, values, traditions, etc. The census survey also delivers detailed data on land property, (change of) land use per field, forest use and other topics related to the management of natural resources.

The process of data analysis is divided into three steps. First, the households of each village are grouped according to a land access and land use classification. In a second step it is checked which of the different cultural indicators are significantly having an impact on the resource use decisions of the respective household groups. Finally, we attempt to create a culture index that is suitable to build a basis for estimations of the effect of cultural driving forces in other rainforest margin areas.

As the data analysis is still to be regarded as a work in progress – especially the third step –, this paper will mainly explain the conceptual framework and methodology of the study and present some first results of linking land access/use groups and cultural indicators (step one and two of the analysis). We expect that land use patterns will depend mainly on the dichotomy of traditional knowledge and skills vs. modern input of these cultural factors and that migration will play an important role in this context. Furthermore, we assume that access to land will be different according to social networks and socio-economic power.

Vanishing wildlife and the dilemma of conservation: The continuous dependence of rural villagers on bush meat in Sabah (Malaysia) on Borneo

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Throughout SE-Asia natural resources are continuously depleted at a rapid rate. The ongoing loss of forest habitat due to land conversion and timber harvesting can be assumed to be a major threat to wildlife species in many SE-Asian rainforests. In Sabah, Malaysian Borneo, around 48 % of the land is estimated to be covered by forests that are disturbed to some extent. However, in order to understand the conservation value of these forests for wildlife one has not only to consider the impact of spatial and structural components of the forest habitats, but also the impact of the local people with their diverse ethnical and economical backgrounds.

Here we present data from a poll of 20 households on economical status and wildlife use of rural villagers of the Kadazan-Dusun tribe from a village (kampung Tumbalang) surrounded by a secondary forest area in Sabah, Malaysia. Villagers rely basically on a subsistence economy with a staple crop of paddy rice, seasonal available fruits and vegetables (field size 2.8 ± 1.5 ha per household) supplemented by wildlife hunted and other materials gathered from the forest (e.g., honey, rattan, medical herbs). Households of 7.1 ± 2.1 persons with 1 – 9 children per family (4.6 ± 1.8), live on a monthly income of RM 120 ± 72.0 (EUR 27.3 ± 16.0) resulting from occasional work in town or from selling agricultural products. The income of families was significantly related to the sell of agricultural products (Spearman's $R = 0.55$, $p < 0.05$, $n = 16$) and the number of domestic chicken ($R = 0,49$, $p < 0.05$, $n = 19$). The consumption of meat gathered from wildlife species (e.g., different species of Artiodactyla, Rodentia and Scandentia) was negatively related to the age of the head of the household ($R = -0.46$, $p < 0.05$, $n = 20$), indicating that hunting proceeds to be a major protein source in the current generation of rural villagers .

Diversity of vascular epiphytes on isolated remnant trees in the Andes of southern Ecuador.

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We studied the diversity of vascular epiphytes on isolated remnant trees of pastures at Estación Cintífica San Francisco (ECSF) in the lower montane forest belt of southern Ecuador (1800-2200m a.s.l.). The objective of this study was to document the importance of remnant trees for the survival of vascular epiphytes following forest clearance. Twenty-one canopy trees (15 remnant trees, 6 forest trees) were divided into five zones following Johansson (1974) and climbed with the single rope technique. Recorded parameters include floristic composition, species richness, abundance and spatial distribution of epiphytes. Bromeliaceae, Orchidaceae, Piperaceae and Polypodiaceae were relatively well represented on remnant trees in terms of species richness and abundance. Other families commonly found on forest trees such as Dryopteridaceae, Ericaceae, Grammitidaceae and Hymenophyllaceae were poorly represented or absent from remnant trees. Diversity as calculated after Shannon and Simpson, species richness and abundance of epiphytes were significantly lower on remnant trees as compared to forest trees. Impoverishment was greatest on the stem base and in the outer crown, and least in the inner crown. We suggest that microclimatic changes such as increased drought stress following the isolation of the remnant trees resulted in lowered rates of establishment and survival of vascular epiphytes.

Bird pollination in South African *Salvia* species

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Approximately one third of the more than 900 world-wide distributed *Salvia* (Lamiaceae) species are ornithophilous. While most of them occur in the New World being pollinated mainly by hummingbirds, only *Salvia africana-lutea* L. from the Cape Province of South Africa is known to be visited by birds (sunbirds and white-eyes). Among the 23 South African *Salvia* species most are insect pollinated.

In the present poster two further species, *S. lanceolata* Lam. and the recently described *S. thermarum* Van Jaarsv., are documented to be pollinated by birds (Lesser Double-collared Sunbird - *Nectarinia chalybea* L.) for the first time.

We illustrate the ornithophilous syndrome in these species: big conspicuous flowers, reduced or deflexed lower lips, no noticeable flower scent and a high volume of low-concentration nectar.

To reconstruct the process of pollen deposition and pollen transfer, simulation experiments were carried out by inserting museum specimens of the five most common flower-visiting birds of the Cape area into fresh flowers. It is evident that each of them is able to pollinate each of the three *Salvia* species. Mechanical isolation thus appears to be lacking.

It has to be investigated whether natural hybrids do occur or by which isolation mechanisms hybridisation is prevented.

Though we cannot exclude the existence of further ornithophilous *Salvia* species in the Old World, their number will never reach that in the New World. Further studies have to deal with the reasons for this example of unbalanced evolution within the large genus.

Relationship between soil properties and tree growth along an altitudinal transect in Ecuador

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The reason for decreasing tree growth rates with increasing altitude in tropical montane forests is not known. One explanation could be chemical and physical soil properties that change in relation to altitude. Therefore, this study assesses the change in soil properties along an altitudinal transect in a tropical montane forest and relates these properties to tree growth.

The study area is located in the south Ecuadorian Andes on the eastern slope of the east cordillera at an altitude of 1900-2500 m above sea level (a.s.l.) between the cities of Loja and Zamora. The mean annual temperature at 1950 m a.s.l. is 16.2°C and the mean annual precipitation 2200 mm. The bedrock consists mainly of shists and sandstones. On permanent monitoring plots in different vegetation units, all horizons of 24 soil profiles (3 profiles at 8 sites) were sampled. Two sites were in slope position between 1960 and 2070 m, six were on the ridge between 1980 and 2450 m a.s.l. We determined the pH, total concentrations of Al, C, Na and of the plant nutrients Ca, K, Mg, Mn, N, P, S, and Zn, as well as polyphenol- and lignin alcohol concentrations.

Most soils are Cambisols, at higher altitude there are also Planosols and Histosols. The concentrations of Mg, Mn, N, P, and S in the O horizon and of Al, C, and all nutrients except Ca in the A horizons correlate significantly negatively with altitude. The C/N, C/P, and C/S ratios increase in O and A horizons with increasing altitude because of the slowdown of litter degradation as a consequence of increasing hydromorphy and decreasing temperatures. The lignin concentration decreases with increasing altitude, possibly because other humus components are faster degraded at lower altitude. The concentrations of the macronutrients Ca, Mg, K, and P correlate significantly positively and the C/N, C/P, and C/S ratios significantly negatively with the growth rate. This indicates that the decreasing availability of Ca, Mg, K, and P and the decreasing nutrient release by mineralization with increasing altitude have a negative effect on tree growth. The polyphenol concentrations in the O horizon are neither correlated with altitude nor with tree growth. Therefore, the hypothesis that polyphenol concentrations in soils are related with tree growth, which is postulated in the literature, cannot be confirmed for our study area.

Types and occurrence of aboveground roots in Amazonian floodplain trees

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The primary function of stilt roots and buttresses is the mechanical support of trees. In Amazonian várzea floodplains, the distribution of these two aboveground root types was correlated with the gradient of flooding, sedimentation and soil properties. This indicates that the production of stilt roots or buttresses seems to depend on the growth strategies related to the environmental conditions of the microhabitat the trees live in.
In the study plots, tree density was low in climax stages, and soil rooted woody vines were observed with more frequency in high-várzea sites. The production of buttresses may be linked to interspecific competition, or to the defense against the establishment of soil rooted woody vines. Buttressing was more frequent in the climax stages in low and high várzea where upper canopy trees reach heights of up to 30-40 m. Buttresses seem to offer better anchorage especially in high canopy trees, which are more exposed to wind loads, whereas the primary function of stilt roots is better aeration in a periodically flooded environment. Since most stilt rooted tree species were small to medium sized and belonged to the C-story, we suppose that the mechanical support of stilt roots – which increase the aboveground root surface more than buttresses – is at best a secondary function in várzea trees.

Net primary production, Biomass and Carbon-stocks In Amazonian white-water forests

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Trees of Central Amazonian white-water forests (várzea) are characterized by the formation of annual growth rings in the wood, because flooding causes periodic cambial dormancy. This enabled us to calculate aboveground wood biomass (AWB) and aboveground wood biomass production (AWBP) in almost undisturbed várzea forests of the Mamirauá Sustainable Development Reserve, middle Solimões River, Brazil. Species composition and forest structure were investigated in a total area of 8 ha. From more than 700 trees >10 cm diameter at breast height (DBH) of different forest types we measured DBH, tree height and crown area. Wood cores were sampled from every tree to determine tree age, radial increments and wood density. AWB of every tree was estimated by basal area multiplied with tree height, wood density and a reduction factor of 0.5. For 23 tree species, growth models of wood biomass accumulation were developed using relationships between age-DBH and age-height. We analysed AWBP in relation to the vertical structure of the stand.

A strong correlation can be found between the crown area and the AWBP of high canopy trees. These trees comprise 70-80 % of the total stand wood biomass increment. The detection of different forest types by aerial photographs and multi-spectral optical-based satellite images (Landsat TM) is possible analysing upper-canopy crown features and supervised TM classification. Based on the scaling up of our data by remote-sensing techniques to a regional scale, we can perform reliable estimations of AWB, AWBP and of the carbon stocks in Amazonian várzea forests.

Nectar sugar composition and nectar volumes of Gentianales from a Southern Ecuadorian montane forest

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Floral nectar is the most important reward offered to pollinators in angiosperms. A general question remains whether nectar features are related to the pollinator type or whether nectar sugar composition is a conservative feature constant within taxonomically related species. Many field-studies on nectar chemistry considering a single syndrome carried out in natural plant communities reveal adaptation to this particular syndrome. Previous studies focusing on nectar sugar composition in phylogenetically related taxa comprising a large variety of pollination syndromes were based on plant material from greenhouses. This study, therefore, investigates 47 taxonomically related species (Gentianales), all native to a tropical montane forest in Southern Ecuador, under natural conditions. Nectar volumes of covered (24 h production) and uncovered (standing crop) flowers were measured. Sucrose, fructose and glucose were quantified in the nectar using high performance liquid chromatography. Flower visitors were observed. Nectar volume is a highly variable intra- and interspecific component. Nectar was sucrose dominant (ratio sucrose/hexose > 1) in ornithophilous, melittophilous and sphingophilous flowers, while a sucrose/hexose ratio < 1 was found in flowers of the chiropterophilous syndrome. Bat-flowers contained large volumes (85.7 ± 17.7µl) of dilute nectars (14.1 ± 5.9% wt/total wt) while bee-flowers contained low volumes (1.6 ± 1.4µl) of highly concentrated nectar (26.5 ± 13.4%). Sugar concentrations in nectars of hummingbird- and moth-flowers were approx. 17% and nectar volumes were intermediate with 16.9 ± 14.2µl and 30.6 ± 16.4µl, respectively. Pollinators in natural habitats generalize by visiting multiple flower types as long as they provide sufficient nectar. Moths, for example, have visited bat-flowers, containing low proportions of sucrose but high nectar amounts, but have not been observed at hummingbird- and bee-flowers which fit their preferred sugar composition but contain low nectar amounts. Corolla lengths further affect flower visitors' foraging strategy, since long corolla tubes protect nectar from generalistic visitors. Finally, plant-animal-interaction may cause rapid adaptations in floral display, while nectar features are influenced by phylogenetic constraints as shown by the similarities of nectar sugar concentration and composition in bee-, hummingbird- and moth-flowers.

Spatial variability of soil physics properties on different scales in Soutern Ecuador

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Within the scope of the DFG-Project "Spatial patterns of parameters and material functions of water, gas and matter dynamics in soils of tropical mountain forests in the South Ecuadorian Andes" parameters and material functions of the water transport in soils are determined as a prerequisite for the quantification of water and matter fluxes in soils. The heterogeneity of hydraulic soil properties is an important characteristic of the soil, concerning parameters like soil texture, bulk density, hydraulic conductivity, amount of stones and material functions like water retention and hydraulic conductivity function. Spatial variability was investigated on two different scales at the "Estación Científica San Francisco" in the South Ecuadorian Andes.

The small scale heterogeneity was investigated on an intensively sampled 4 meter wide and 1.5 meter deep soil profile face. Two- and three-dimensional simulations of water flow were carried out. On the bigger scale spatial variability was examined at approximately 90 sampling points of different sampling intensity located in two micro-catchments. Spatial variability was investigated with different methods of geostatistics which were compared.

The simulations on the small scale show that spatial variability has a big impact on water fluxes, causing patterns with much higher water flow velocities and preferential flow on the one hand and zones with very low water movement on the other hand. The spatial variability on the micro-catchment scale is also very high, leading to a highly different hydraulic behaviour of the soils in different parts of the micro-catchment.

Keywords: soil physics parameters, spatial variability, simulation of water flux, geostatistics

Small mammals in Namibia: Aspects of diversity and reproduction

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Small mammal diversity and reproduction was assessed in three sampling sessions at the end of the rainy season between 2001 and 2003 along a transect covering a rainfall gradient in Namibia. A total of 16 species (350 specimens) of Soricidae, Rodentia, and Macroscelidea were captured. Species richness was highest in the farming area north of Windhoek, whereas it was low in an overgrazed site in the drier south. Reproductive data supports reproduction after the rainy season.

Additionally, an in depth population ecology study was conducted in the south. This investigation indicated higher diversity and higher abundance of small mammals in Gellap-Ost (low grazing pressure) compared to Nabaos (overgrazed), with *Tatera leucogaster* as the most abundant species in Gellap Ost and *Gerbillurus vallinus* in Nabaos, where *Tatera* did not occur at all. This part of the study demonstrates the value of small mammals as indicators.

Spectrum of bromeliad-associated arthropods differs with plant species and microhabitat

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The purpose of this study was to compare the invertebrate fauna inhabiting bromeliad phytotelmata and terraria to evaluate the influence of plant species and microhabitat (height) on the species richness of the bromeliad-associated fauna in the Atlantic rain forest of Santa Catarina Island, southern Brazil. Of 4 common species of bromeliads, *Aechmea lindenii, A. nudicaulis*, *Canistrum lindenii* and *Nidularium innocentii*, about 60 plants growing on the forest floor were sampled. Specimens of a fifth species, *Vriesea vagans*, were collected from the canopy at heights between 12 and 15 m. For a complete inventory of the associated macroinvertebrates larger than 1 mm, all plants were taken to the laboratory were they were inspected leaf by leaf. Immatures of several insect orders were reared to imagines to enable the association between larvae and adults and to facilitate identification. The animals were identified mostly to family level and classified into morphospecies. Species richness per plant species varied between 100 to 170 for the terrestrial bromeliads whereas only around 60 species were recorded in epiphytic *V. vagans*. Ants were the most abundant taxon, followed by flies, beetles and spiders. The latter two also dominated in terms of species richness due to the high number of singletons. However, between 20 to 80% of the beetles recorded were aquatic larvae of Scirtidae and occurred in all bromeliad species. Spiders of only five families were frequently associated with bromeliads making up 10 to 20% of the total spider sample, and two of them were exclusively associated with terrestrial bromeliads. The nymphs of 4 species of *Leptagrion* (Odonata) were unevenly distributed among bromeliad species. *Leptagrion* n. sp. was only found in epiphytic bromeliads, while around 75% of *L. macrurum* and *L. perlongum* were associated to terrestrial *C. lindenii* and *N. innocentii*, respectively. This pattern is interpreted as a partitioning of spatial niches between species with similar predatory diets. Other taxa of bromeliad-dwelling insects such as *Paravelia recens* (Hemiptera), *Desmopachria* sp. (Coleoptera), *Phylloicus* cf. *bromeliarum* (Trichoptera), and psychodid and syrphid dipterans were also restricted to certain ground-dwelling bromeliads. These findings suggest that, at least for some species, their occurrence in bromeliads is influenced by plant specificity or habitat preference. Funded by BMBF, Germany (01LB0205) and CNPq, Brazil, (690143/01-0).

Adaptation to climate in enset landraces: changes in the leaf anatomy

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Enset (*Ensete ventricosum*: Musaceae) shows remarkable adaptation to seasonal climates in its leaf anatomy. It grows wild in Africa with an altitudinal distribution between 800 m (Angola) and 2000 m (Eastern Africa), and an average rainfall between 1000 and 1500 mm. Main cultivation areas are restricted to southern and south-western Ethiopia at 1300 to 3300 meters. Farmers cultivate numerous landraces for manifold purposes, as well as for different requirements of site and climate.

Field investigations were carried out with sprouts from vegetative propagated at two sites in Ethiopia (Debre Zeit, 1850 m, and Addis Ababa, 2350 m). Average temperature and rainfall patterns varied throughout the seasons (17.1°C, 2805 hours of sunshine, 858.4 mm rainfall in 96.6 days at 1850 m; 16.1°C, 2576 hours, 1127.4 mm in 169.9 days at 2350 m). One wild enset type was propagated in February, April and August 1998, and 10 landraces and 1 wild type in August 1998.

Results showed differences in stomata number, stomata anatomy, and in the transverse section of the leaves. Stomata number per mm^2 and size increased with the plants' age. Transverse sections of the leaves show upper and underneath epidermis, hypodermis, parenchym and mesenchym. Observing the transverse section, number of layers increased with the plants' age, and was highest during dry periods (November 1998-February 1999). Additional hypodermis layers might relate to succulent properties to avoid leaf water loss under dry spells. Radiation seems to have no or only a slight influence on the leaf anatomy. Plants seemed to need to have reached an age of about 8 months to develop additional hypodermis layers; they were not developed by plants propagated in August. Coloration of these leaf cuttings with iodine did not show any coloration. Therefore, sufficient starch was not developed at this stage, and plants did not store sufficient assimilates to develop additional layers.

Landraces showed differences in stomata number, shape and transverse sections of the leaves. Results allow grouping of landraces into similar groups, which correspond with measurements on vegetative parameter. Classification into related groups should be confirmed by genetic analysis. Moreover, specific instructions can be given to the farmers to optimize cultivation in the different regions.

Author Index

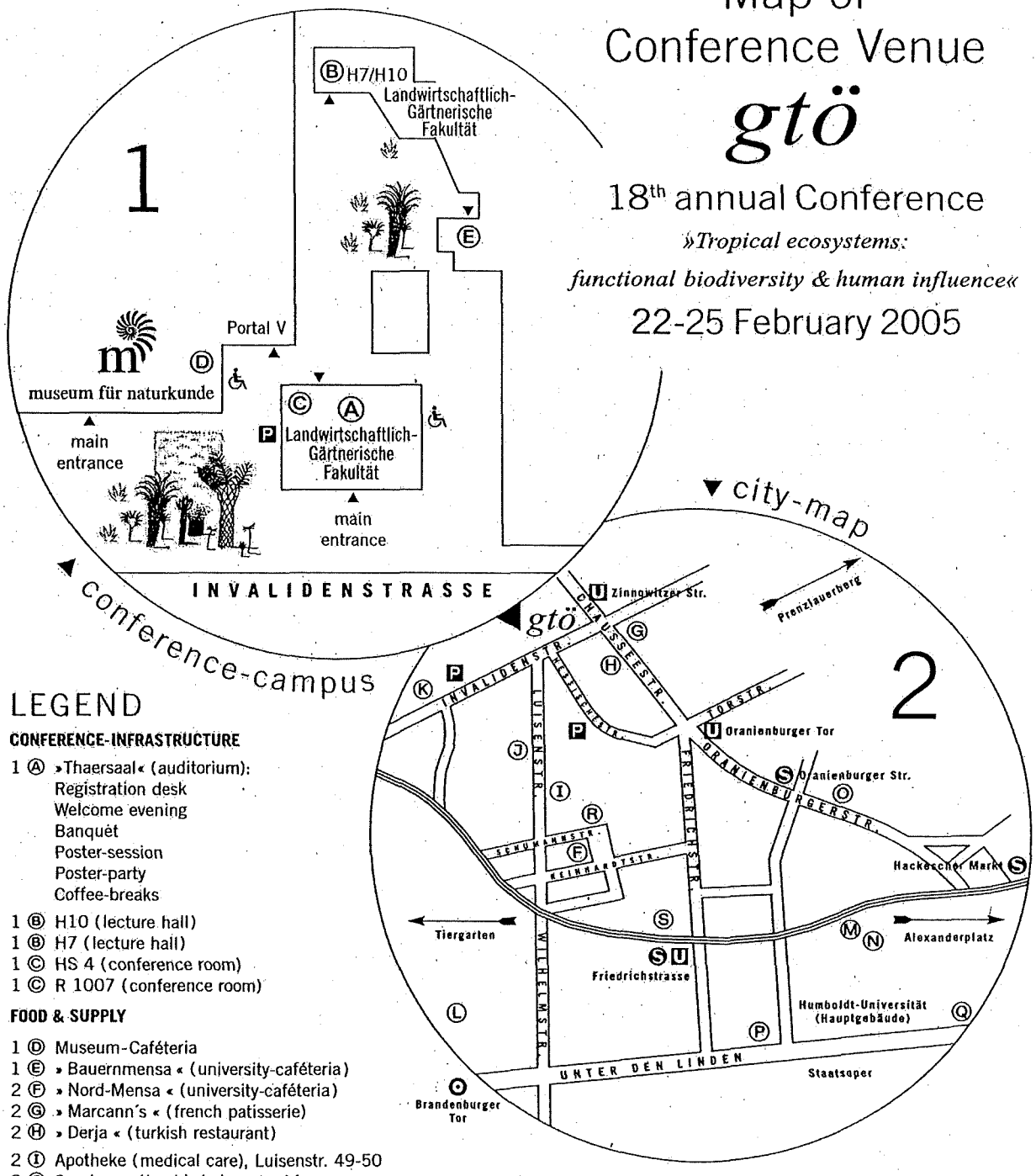
Map of Conference Venue

gtö

18th annual Conference

»Tropical ecosystems: functional biodiversity & human influence«

22-25 February 2005



LEGEND

CONFERENCE-INFRASTRUCTURE

1 Ⓐ »Thaersaal« (auditorium):
- Registration desk
- Welcome evening
- Banquet
- Poster-session
- Poster-party
- Coffee-breaks

1 Ⓑ H10 (lecture hall)
1 Ⓑ H7 (lecture hall)
1 Ⓒ HS 4 (conference room)
1 Ⓒ R 1007 (conference room)

FOOD & SUPPLY

1 Ⓓ Museum-Caféteria
1 Ⓔ » Bauernmensa « (university-caféteria)
2 Ⓕ » Nord-Mensa « (university-caféteria)
2 Ⓖ » Marcann's « (french patisserie)
2 Ⓗ » Derja « (turkish restaurant)
2 Ⓘ Apotheke (medical care), Luisenstr. 49-50
2 Ⓙ Sparkasse (bank), Luisenstr. 44

NEARBY SIGHTS / LOCATIONS OF CULTURAL INTEREST

2 Ⓚ Hamburger Bahnhof (contemporary art)
2 Ⓛ Bundestag
2 Ⓜ Pergamon-Museum
2 Ⓝ Alte Nationalgalerie
2 Ⓞ Synagoge
2 Ⓟ Staatsbibliothek
2 Ⓠ Deutsches Historisches Museum
2 Ⓡ Deutsches Theater
2 Ⓢ Berliner Ensemble

SYMBOLS

- ▲ main entrance ways
- Ⓢ S-Bahn / city-train
- Ⓤ U-Bahn / subway
- ♿ entrance ways for disabled people
- P parking lots

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»Tropical ecosystems: functional biodiversity & human influence«

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Appendix

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Structural features of two rain forests in East Africa under different disturbance history - A comparison between the Budongo Forest, Uganda and the Kakamega Forest, Kenya

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Forest remnants in East Africa underlie heavy pressure since decades with various intensities. Utilisation, deforestation and different forms of tree species selections under growing populations are the most characteristic features. From two different raqin forest systems, the Kakamega Forest in Kenya and the Budongo Forest in Uganda the history of utilisation is known quite well. In case of the Budongo Forest, some parts of the forest suffered heavily from logging and deforestion, but the process was stopped. Therefore it gives us the possibility of a comparison of effects between ongoing activities and past activities on structural parameters of the forests.

Mainly species composition (which is expected to be different between the two sites), tree density, stem size distribution, tree height and other parameters were investigated in different parts of the two forests with a partly known history of these stands.
Results are compared with the known forest development of the Budongo Forest and analysed according their significance of disturbance on structural parameters of East African rain forests.

Baseline monitoring of forest conservation in the influence zone of a gas pipeline in Bolivia: an approach evaluating anthropogenic forest use

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A monitoring system that allowed regular evaluation of the forest conservation status in the influence zone of a gas pipeline in Bolivia was developed. The Chiquitano dry forest in East Bolivia is an ecosystem still close to natural conditions. In December 2000 a pipeline crossing the forest to export gas to Brazil came into operation. The pipeline cut through the forest and its direct impact on the vegetation cover was discernible.

However, the interaction between the endogenous socio-economic activities from long-established village population, and the enhanced forest accessibility into the forest through the pipeline's right of way, will generate long-range indirect impact. Forest degradation and deforestation need further monitoring to assess possible effects and to develop means to minimize harmful impacts on the forest ecosystems.

The monitoring system consists of two fuzzy logic knowledge-based models for spatial evaluation; which integrate primary socio-economic data related to anthropogenic pressure, with land cover information obtained from a Landsat ETM image. The spatial representation of the results is supported by means of GIS. Each model corresponds to an evaluation level:

- Village level, including factors with influence inside of villages
- Meso-level, comprising factors with influence outside of villages' edges

At village level the evaluation criterion follows: the pressure on forest lands due to extensive agriculture is maintained within critical limits. This pressure is determined by two factors: level of commercialisation of farm products and level of agricultural extensification.

At meso-level the evaluation criterion follows: change in land use as result of human intervention is maintained within critical limits. The factors influencing the ecosystem outside of villages are structured and interrelated according to their scopes of influence, having a heterogeneous distribution in the space. Since they do not affect the overall study area in the same way, four pressure areas exist: clearings, fuelwood collection, cattle browsing, and logging areas.

The baseline monitoring and evaluation results have shown that at village level, there is either a strong or moderate pressure on the surrounding forest due to the agricultural practices, because the farming is fully extensive. At meso-level, 82,96% of the total area under study has a very good conservation status and 3,67% correspond to total deforested areas; 12,66% of the ecosystem's area show either a good (11,33 %) or a moderate (1,84 %) conservation status and only 0,19% show a poor conservation level.

A Meta Database as Basis for Modelling Water and Nutrient Fluxes in a Tropical Mountain Forest, 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 it is obvious that a sophisticated database is needed to share the results of the working groups. Such a database is implemented using common open source software. The modular concept and the complex relational structure of the database guarantee easy and quick updatability as new datasets are produced by the research group.

On the bases of this data, the analysis of atmospherical fluxes as well as the prognostical and retrospective simulation of the spatial distribution of vegetation is done using numerical soil-vegetation-atmosphere-transfer schemes (SVAT). At the same time this model output is the lower margin condition for climatic mesoscale models (e.g. MM5) run by another working group. In order to simulate precipitation and cloud fields with mesoscale models the lower conditions have to be as exact as possible. New SVAT models like the Community Land Model (CLM) are able to deal with a distinct vegetation cover in multiple spatial resolutions.

Terrestrial measurements of the vegetation, hydrology and other parameters in the study area in South Ecuador imply a spatial resolution of ca. 200-500 m for each modelling grid cell. Vegetation can be described in terms of abundance of Plant Functional Types (PFT) for each grid cell. On top of mean values for each biome, the percentage cover of different PFT, waterbodies and bare soil is stated for each grid cell. This assumes the availability of a vegetation classification at a resolution finer than that of a grid cell.

Dependent on space and time, biophysical parameters (e.g. leaf area index, LAI) for each PFT are needed. These parameters can be obtained from remote sensing data using transfer functions of spectral vegetation indices (VI) or inverting radiation models to the vegetation canopy. First results of using different VI to calculate LAI and the validation with different ground measurements of the LAI are represented.

The paper shows how the database of the research group 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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Water use and growth response of a strongly seasonal dry forest at the West Andean foothills in North Peru

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While very close to the equator and the Pacific ocean, the foothills of the Cordillera in South Ecuador and North Peru are covered by deciduous dry forests. The geographic location near the westernmost coast of South America, where the cold Humboldt current and the warm equatorial current constantly change their off-coast position, causes a highly variable precipitation regime. In normal years, the southern equatorial coastal region of the dry forests receives no more than 200 mm of rain and is strongly affected by a dry season and lasts up to 8 months. However, multi-annual cycles of ENSO events are superimposed to the annual regime bringing in very short time torrential rains with an often more than ten fold increase in annual precipitation. To cope with the highly variable and seasonal water availability, tree species of the dry forests have developed morphologic features and physiologic strategies to survive water scarcity over long periods. To study the role of special water uptake patterns, water storage capacity and transpiration control by dry forest tree species, we investigate the questions: 1) When and how much water is used by trees and is this a significant part of the total precipitation? 2) Does water use by the seasonal understorey play an important role in the water cycle and is the removal of understorey by cattle grazing having an effect on the water cycle? 3) Do dry forest tree species respond to ENSO events by tree growth, water storage or eco-physiological adaptations? The study is been conducted at the Game Reserve of El Angolo in north Peru. Since summer 2004, continuous measurements of water flux, soil moisture and climate conditions are performed in the dry forest under two different conditions: One study site is an experimental plot of 1 ha that was closed in 1988 with a fence to exclude disturbance of the understory by cows. Adjacent, is a study site were most of the annual understorey vegetation is removed by extensive cattle grazing, which is the common practice in the dry forests. We conduct measurements on 18 trees of the most common species, 1 evergreen species (Caesalpinia paipai) and five deciduous species (Loxopterigium huasango, Ceiba trichistandra, Eriotheca ruizii, Erythrina smithiana, Bursera graveolens).

Where ends the edge? Survival and fitness of Tapirira guianensis Aubl. (Anacardiaceae) seedlings in a Mata Atlântica rainforest fragment of Pernambuco, Brazil*

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Tapirira guianensis is one of the most abundant tree species in the fragments of the Mata Atlântica lowland rainforests of Pernambuco, Brazil. As part of the project described below, the fitness of Tapirira guianensis seedlings was observed in 33 sampling plots under three adult trees of the forest border and in 33 plots of the forest interior. Total number of seedlings of each plot and the number of leaves of each seedling were registered. Additionally, we studied the survival and development of seedlings transplanted into containers with equal edaphic conditions at each of the two habitats, with control transplantations at open places and forest gap sites.

After one year of observation, from seed fall on, we could not find a significant higher leaf number of the edge seedlings, as it was possible in the first two months of observation. However, their survival rate was clearly higher, especially when only comparing the plots of the edge trees directly situated at the forest border (distance 0-10 m from forest edge) (median of survival rate=37.5%, n=21) with the plots of that interior trees which do not have neighbouring forest gaps (median of survival rate = 8.1%, n=22, p=0.002, Mann-Whitney U: 103.5). Including also the plots of trees more distant (20-25 m) from the edge and the plots of interior trees with gaps nearby, the differences are less significant (medians of 26.7% vs. 13.9%, n=33, p=0.055, Mann-Whitney U: 395). Accordingly, the survival rate of the transplanted seedlings after nine months was higher at the forest border (58%) than in the interior (25%) with survival rates of 92% in the forest gap and 0% in the open places control treatments.

Supported by light measurements that show a twice as high relative light intensity for the sensu stricto edge plots than for the interior plots, we suppose that the observed edge effect on survival and development of Tapirira guianensis seedlings is clearly light dependent, and that the species therefore is rather favoured by forest fragmentation.

*Research 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.

Carbon source does not influence □^{13}C of tropical cyanobacteria?!

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Tropical terrestrial cyanobacteria are predominating organisms in many ecosystems with extreme climatic conditions (tropical stone formations: inselbergs, table mountains, rocky out crops). Only rare information exists about the carbon cycle of terrestrial cyanobacteria. The □^{13}C of cyanobacterial organic matter is thought to be influenced by the isotopic composition of the inorganic nutrients and fractionation processes during uptake, metabolism and catabolism. It was speculated that (i) uptake of different inorganic carbon-species (C_i), which can be HCO_3^- (□^{13}C ~0‰) or CO_2 (□^{13}C ~ -8‰), lead to the high heterogeneity of cyanobacterial □^{13}C. Furthermore, (ii) higher activity of a CO_2-concentration mechanism (CCM) could lead to an enrichment, which would also influence □^{13}C. As third possible factor, (iii) the higher CO_2-diffusion resistance is discussed resulting in enriched □^{13}C.

We tested these three hypothesis with two tropical terrestrial cyanobacteria (*Chroococcidiopsis, Scytonema*) and mutants of cosmopolitic *Synecocystis* spec. PCC6308 with different defects of their C_i-uptake-system. Contrary to first hypotheses, cyanobacteria grown under high CO_2 supply were not depleted in □^{13}C than those under HCO_3^- supply. The activity of CCM had an influence on □^{13}C. With high apparent affinity of net fixation to external C_i, □^{13}C were depleted and vice versa. Moreover, the third hypotheses can be accepted, since increased CO_2-diffusion resistance caused by a thicker extracellular polysaccharid sheath correlated with enriched □^{13}C.

A scaling of all results showed that the uptaken C_i-species had no influence on □^{13}C. Instead, C_i-limitation in general leads to a lower discrimination against □^{13}C which is further influenced by the effectiveness of CCM activity. Secondly, the thickness of EPS effects the diffusion resistance and causes C_i-limitation.

For the first time, the results present a valuation of different processes and their influence on □^{13}C of cyanobacteria, which are distinguished clearly from that of Higher plants.

Propagation of native tree species of the tropical mountainous rain forest in South Ecuador

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Ecuador's deforestation rate is one of the highest worldwide. In combination with a non sustainable pasture management as one of the common land use practices in the region, deforestation leads to a marked decline of biodiversity as well as a loss of the basis for timber production. The colonization of abandoned pastures with trees by natural means takes place in extended periods of time (up to 30 years and more), so a well managed reforestation presents the unique possibility to weave the sites into production within short terms.

Because of the regions' utmost importance as a biodiversity hotspot and local demands of small scale timber processing enterprises and people, in reforestation native tree species should be prioritized to commonly planted exotic species. However, a lack of scientific knowledge about qualitative and quantitative parameters of seed resources, eg. population densities of seed collection stands, reproductive phenology as well as unknown germination behaviour and growth performance poses a challenge to an organized and well managed propagation project.

In cooperation with the DFG-Project "Reforestation of abandoned pastures with native tree species of tropical mountainous rain forest in South Ecuador", trials were conducted in the forest nursery in Loja, South Ecuador, to optimize the supply of high quality seed material of native tree species as well as the optimal germination and propagation environments. The trial designs (split plot design with 3 factors) included trials to the species' germination and the plants' initial growth. Eight tree species native to the mountainous rain forest region, different light intensities and growing media (nurseries' standard soil, standard + forest soil, standard + compost, standard + sand) served as the trials' factors leading to identify the species' response concerning the germination rate, mortality, and the plants' growth.

Germination rates differed not only between the selected tree species, the species also favoured different germination environments. Some species (i. e. *Clethra revoluta*) seemed to germinate better in an sandy environment, *Cedrela montana* favoured the standard substrate while *Alnus acuminata* showed highest results in a substrate with forest soil. Germination media containing compost show a higher attraction for nursery pathogens, eg. fungus gnats in the substrate.

The findings serve as a basis for appropriate bulk propagation techniques of native tree species for reforestations.

Plant diversity in disturbed forest and agroforestry systems of coastal Ecuador

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Tropical forest conservation has been managed traditionally through the preservation of old-growth forest. Today, isolated forest fragments, logged forest, secondary growth forest, and agroforestry, are recognized for their value in conservation of biological diversity, because of the continuous loss of old-growth forest and the change to highly fragmented, logged forest fragments and agroecosystems. Intervened forest, abandoned and managed agroforestry are common land-use types in coastal Ecuador.

We studied species richness, floristic composition, and population structure in intervened forest, 12-15 yr-old abandoned coffee and actively managed coffee agroforestry. In addition to tree diversity, we analyzed the role of these managed and abandoned land-use types for forest regeneration assessing the diversity of saplings, and seedlings. Tree species richness was similar among the three selected land-use types while seedling richness was significantly different: the diversity of endemic and rare species was similar between intervened forest and abandoned coffee, but lower in managed coffee agroforestry. Sorenson's quantitative index of all pairwise comparisons showed that floristic composition of seedlings was similar between intervened forest and abandoned coffee while that of coffee agroforestry was significantly different. Canopy height and cover were also similar between logged forest and abandoned coffee and significantly different from coffee agroforestry. Only basal area was found to be similar in all three land-use types.

We conclude that intervened forest and abandoned coffee appear to have a similar conservation value for plant diversity. The high diversity and abundance of seedlings and saplings in intervened forest and abandoned coffee may indicate a similar pattern of forest recovery among these land-use types. The lower species richness and abundance of seedlings and saplings in managed coffee agroforestry is due to stronger human interference, mainly the manual removal of weeds. However tree diversity appears to be well preserved in agroforestry systems.

Analysing fragmentation and disturbance of East-African rainforests by means of remotely-sensed time series data and landscape metrics

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Within the 15 BIOTA East Africa subprojects the influence of fragmentation and human use on the biodiversity of East-African rainforests is investigated by following an interdisciplinary and integrated research approach. Especially when aiming at recommendations for sustainable biodiversity management at the landscape level and including global change aspects, biodiversity research is in need of geo-spatial data. Here, remote sensing data provide a valuable means to producing the needed time series.
For seven time steps between 1972 and 2001 Landsat ETM+, TM and MSS data have been acquired for the Kakamega Forest and its associated forest areas in Western Kenya. The data processing involved a supervised multispectral classification. Based on ground truthing with the use of amateur photographs taken during an aeroplane flight as well as maps showing vegetation types and land cover for different years, 12 land cover classes could be distinguished, of which 6 belong to forest formations.
These classification results have been analysed in several ways. i) Changes in areas and portions of land cover classes have been determined for the observation plots, the areas within the official forest boundaries as well as the total forested area. ii) Landscape metrics based on a moving window approach allow us to look into forest fragmentation and disturbance by separating human-induced influences in two classes. The results show a distinct spatial pattern of fragmentation over time as well as different disturbance histories for the forest reserves under investigation.
In contrast to separate evaluations of each time step, iii) a cluster analysis resulted in types of characteristic changes in land cover from 1972 to 2001, i.e. spatial regions are formed that are alike regarding their specific forest history. Therefore, the striking developments over the past 30 years are visualized in a single map presentation. Extensive forest loss can be noticed for the South Nandi Forest and the north-western part of the Kakamega Forest as well as along almost all forest edges, as opposed to the regeneration of the Kakamega Forest in its north-central and north-eastern part.

The results may allow for extrapolation of field-based findings in space and time and thus contribute to the understanding of ecosystem processes and biodiversity changes in tropical rainforests as investigated by the other subprojects.

Canopy structure define abiotic parameter in forests: Does it influence plant diversity?

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In the last years tree diversity, canopy structure and throughfall chemistry were investigated. Different forest types at two study sites were compared. The first site is the Estación Científica San Francisco in South Ecuador with around 2100mm precipitation at 1950m asl. The second site is the Kakamega Forest in Kenya, a guineo-congolian forest with 2200mm precipitation at 1600m asl. At each site a triplet of 20 x 20m plots were installed in three forest types. All trees in the plots were determined and measured. Hemispherical images in all plots were taken to describe the canopy structure with parameters such as canopy openness, LAI, and radiation. Measurement positions and throughfall collectors were installed in a 5m grid system. Over one year period the throughfall was collected and analysed for it's content.

The sites differ in their tree species composition, stand structure, biodiversity indices and throughfall. All plots cover a wide range of canopy structures and throughfall chemistry. Parameters of canopy structure correlate with light values and throughfall amounts. Tree diversity correlates with standard deviation of throughfall content. A more divers forest shows a wider range of different nutrient input patterns than a less divers forest.

The canopy structure defines abiotic parameters like light, water, and nutrients in the understorey. These parameters define the niches for the seedlings. If a high divers forest defines more different niches and a less divers forest defines less different niches, more species can establish the divers forest and the diversity preserve the diversity.

Species richness and density of coffee flower-visiting bees depend on agroforestry management

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Intensification of agricultural systems affects bee diversity, while traditional agroforestry-systems are considered to harbour high species numbers. Agroforestry systems may differ in the criterias affecting bee diversity. Typical characteristics of coffee-agroforestry systems are a diverse canopy, inducing a certain light regime and structural heterogeneity. Another important determinant of pollinator diversity

is the availability of resources in these systems.

We observed coffee-flower-visiting bees in 22 agroforestry systems, in Manabi, Ecuador; comprising *Coffea arabica*. Sites constituted gradients of habitat characteristics, including diversity of shade trees, light intensity, and as a measurement for structural heterogeneity the coefficient of variation of the trees' altitude. To quantify resource availability we calculated the proportion of flowering coffee shrubs per site, number of flower bunches on each observed coffee shrub, and percent cover of all blooming non-coffee plants.

Altogether thirty bee species were observed. In a multiple regression model species richness increased with diversity of shade trees ($F = 5.56$, $r^2 = 0.22$, $n = 22$, $p < 0.05$); light intensity or canopies' structure did not show any effect. Density of flower visitors increased with the number of flower bunches on the observed shrub, and with decreasing proportion of blooming shrubs in a coffee plantation ($F = 16.16$, $r = 0.62$, $p < 0.001$). Percent cover of flowering herbs did not affect bee density, nor did resource availability affect species number.

The results suggest that a diverse canopy and the combination of successively rather than synchronously flowering coffee shrubs, with a high number of flowers per shrub, favour a species rich community and high densities of coffee-flower visiting bees and thus should be considered in management schemes.

Predicting areas of high conservation priority for West-African Amphibians using satellite imagery.

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West Africa has to be recognised as a major amphibian biodiversity hotspot. More than 14 years of research throughout West Africa revealed a much higher amphibian diversity than previously assumed. Many new and cryptic species, as well as richer local species assemblages have been recorded. However, amphibians in West Africa are highly threatened by anthropogenic induced habitat modification. Especially forest species have been shown to be severely influenced by fragmentation and logging. A major aim of this study is to predict areas of high conservation priority and understanding the impact of anthropogenic induced habitat alterations. We investigated environmental parameters derived by remotely sensed data and correlated them to amphibian diversity. GIS/RS derived data are valuable tools due to their broad spatial and temporal resolution and their comparatively easy applicability. They can be used for a region wide spatial prediction of amphibians and consequently for highlighting areas of conservation priorities. We compiled amphibian community data for 484 species at 77 sites of 23 African countries. The species data base consist of own data, data gathered from the literature and museum collections. Our results highlighted biodiversity hotspots across West Africa and were used to predict areas of prime conservation importance.

Floristic Composition, Stand Structure and Soils of the Lower Montane Forests over Tropical Karst in the Yuracyacu Valley, Cordillera Oriental, Peru

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The base of the Cordillera Oriental along the Rio Alto Mayo in north-eastern Peru is partly composed of metamorphic rocks and Jurassic limestone leading to the formation of tropical Karst. The rivers and tributary creeks draining these mountains towards the Amazon formed steep valleys with occasionally dry creek beds during times of less precipitation. The valley of the Rio Yuracyacu draining into the Rio Mayo near Rioja is a typical example of this geomorphologic and hydrologic type. The area of the Yuracyacu is densely covered by tropical forests and fairly undisturbed areas as well as pristine forests can be found along the elevation gradient ranging from 1000 to 3400m a. s. l. This part of the Cordillera Oriental was historically neither populated by pre-colonial Indian highland cultures nor by Native American lowland tribes. In the mid 1980s a moderate colonization of the lower valley slopes set in, - mainly for subsistence farming and coffee production by settlers immigrating from the Andean highlands.

We explored along the middle course of the Rio Yuracyacu the relief morphology, soils, stand structure and floristic composition of the vegetation types encountered between 1000 - 2400 m a. s. l. We compare the results from the metamorphic bedrock area and the tropical Karst region with information which was collected during previous studies in the adjacent Cordillera Cahuapanas over poor tropical soils derived from Cretaceous sandstones. Since for the Yuracyacu vs. Cahuapanas a geographic floristic separation does practically not exist and local climate and slope conditions are similar, but bedrock geology is very different, it was tested whether soil development over such contrasting geology is indeed significantly different and results in floristically and structurally different montane forest types.