16. Jahrestagung der

Gesellschaft für Tropenökologie

19. - 22. Februar 2003

Universität Rostock

gtö

Tagungsband

Tropische Biodiversität im globalen Wandel

Deutsche Forschungsgemeinschaft DFG

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Gesellschaft für Tropenökologie e. V.

Tagungsband

16. Jahrestagung in Rostock

Tropische Biodiversität im globalen Wandel

Klimawandel und Ökosystemdynamik
Fragmentierung und Habitatinseln
Landnutzungsveränderungen
Tier-Pflanze-Interaktionen
Ökosystemregeneration

19. - 22. Februar 2003

Inhaltsverzeichnis

Die Veranstalter

Leitung

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Willkommen in Rostock!

Das Organisationsteam der Abteilung Allgemeine und Spezielle Botanik, heißt alle Teilnehmer und Gäste herzlich willkommen! Wir hoffen, dass Sie die diesjährige gtö-Tagung in Rostock als informativ und inspirierend in Erinnerung behalten werden, und wünschen Ihnen einen angenehmen Aufenthalt!

Universität Rostock

Die ALMA MATER ROSTOCHIENSIS, gegründet 1419, ist eine der ältesten Universitäten Deutschlands und die älteste im Ostseeraum. Mit der Juristischen und der Medizinischen Fakultät sowie der Facultas artium, der späteren Philosophischen Fakultät, nahm die Universität seinerzeit den Lehrbetrieb auf. Die Theologische Fakultät vervollständigte erst ab 1432 den Rahmen der vier Traditionsfakultäten eines "studium generale". Verkörpert werden diese vier ältesten Fakultäten durch die vier Pfeiler und deren Figuren am Universitäts-Hauptgebäude. Das Hauptgebäude, in dem sich auch die Aula befindet, wurde 1870 im Stil der mecklenburgischen Renaissance errichtet.

Zu den vier Traditionsfakultäten kommen heute die Agrar- und Umweltwissenschaftliche, die Ingenieurwissenschaftliche, die Mathematisch-Naturwissenschaftliche und die Wirtschafts- und Sozialwissenschaftliche Fakultät hinzu. Mit einem Angebot von über 50 Studiengängen, die durch eine Vielzahl postgradualer Studiengänge ergänzt werden, gehört die Universität Rostock damit zu den Hochschulen Deutschlands mit dem breitesten Fächerspektrum.

Gegenwärtig sind an der Rostocker ALMA MATER fast 12.000 Direktstudenten immatrikuliert, darunter über 400 ausländische Studenten und Promotionsstudenten aus über 80 Ländern. Ihnen stehen derzeit ca. 3100 Mitarbeiter an der Medizinischen Fakultät und 1600 Mitarbeiter in den übrigen Fakultäten gegenüber. Mit dieser vergleichsweise günstigen Betreuungsrelation für Studenten ist Rostock alles andere als eine Massenuniversität.

Eine der wichtigsten Einrichtungen für die Studierenden und Mitarbeiter ist die bereits 1569 gegründete **Universitätsbibliothek**. Sie hat einen Gesamtbestand von rund 1,9 Mio. Bänden, darunter 4.100 laufend gehaltene Zeitschriften, 325.000 Hochschulschriften, 34.000 Bände in Lehrbuchsammlungen, ca. 2.800 Handschriften und Autographen, 650 Inkunabeln sowie 14 Nachlässe.

Das Internationale Begegnungszentrum (IBZ Rostock e.V.)

Das IBZ ist ein gemeinnütziger Verein, der aus dem Zusammenschluss der Universität, der Hochschule für Musik und Theater sowie weiteren Forschungseinrichtungen der Region Rostock hervorgegangen ist und sich zum Ziel gesetzt hat, Wissenschaftler, auch mit ihren Familien, aus den unterschiedlichen Disziplinen und Nationen miteinander in Kontakt zu bringen, den wissenschaftlichen Austausch zu fördern und einen kulturellen Austausch mit allen Mitgliedern der Universität, den beteiligten wissenschaftlichen Einrichtungen und auch den Bürgern der Stadt zu ermöglichen. Gastwissenschaftlern bietet das IBZ daher Wohnungen verschiedener Größe sowie einen Gemeinschaftsbereich mit Teeküche, Empfangs-, Vortrags-, Lese- und TV-Raum.

Der Fachbereich Biowissenschaften

Der Fachbereich Biowissenschaften, dem 17 Professoren, 32 wissenschaftliche Assistenten, 76 fachpraktische und weitere Mitarbeiter angehören, befindet sich z. Z. noch in einer Umstrukturierungsphase. In deren Verlauf sollen sich Forschung und Lehre auch räumlich in vier Instituten konzentrieren, die sich gegenwärtig noch auf mehrere Standorte in der ganzen Stadt verteilen:

- Institut für Biodiversitätsforschung
- Institut für Zellbiologie und Biosystemtechnik
- Institut für Molekulare Physiologie und Biotechnologie
- Institut für Aquatische Ökologie

Die lokale Zersplitterung wurde mit dem Neubau des Naturwissenschaftlichen Lehrgebäudes in der Südstadt schon z. T. behoben.
Die Aufgaben des Fachbereichs Biowissenschaften konzentrieren sich auf Lehre und Forschung, umfassen aber auch Artenpflege und -erhalt (Fritz-Paul-Müller-Stiftung, Botanischer Garten). Durch massives Einwerben von Drittmitteln für Forschungsprojekte in Millionenhöhe und durch die damit möglich gewordene gerätetechnische Erneuerung sowie durch eine breite nationale und internationale Zusammenarbeit verfügt der Fachbereich Biowissenschaften heute über ein leistungsfähiges Forschungspotenzial.

Das Institut für Biodiversitätsforschung

Das Institut gliedert sich in die Abteilungen

- Fachdidaktik Biologie,
- Stoffwechselphysiologie,
- Allgemeine und Spezielle Zoologie und
- Allgemeine und Spezielle Botanik.

Gastgeber der diesjährigen Tagung ist die Abteilung A&S Botanik (Leitung Prof. Dr. Stefan Porembski).

Forschungsschwerpunkte der Abt. Allgemeine und Spezielle Botanik

- Biodiversitätssteuernde Mechanismen in Habitatfragmenten (Inselberge, Waldinseln, Sölle)
- Zeitliche Diversitätsmuster (Artenturnover)
- Räumliche Diversitätsmuster (Gradientenanalysen, Analyse der Determinanten von alpha-, beta-, gamma- Diversität)
- Pflanzliche Anpassungsstrategien an Extremstandorte
- Biosystematik und Biogeographie
- Bioindikation in Stand- und Fließgewässern (Dr. Th. Hübener)
- Paläolimnologie (Dr. Th. Hübener)
- Phytoplanktonsukzession in Fließgewässern (Dr. Th. Hübener)

Weitere Einrichtungen des Institutes für Biodiversitätsforschung:

Einen **Botanischen Garten** an der Universität Rostock gibt es seit 1885. Er wurde von Karl von GOEBEL begründet (Ordinarius für Botanik in Rostock 1882-1887). Vorher haben hier seit dem 16. Jahrhundert Arzneipflanzen-Gärten und auch interessante Pflanzensammlungen in privater Hand existiert. Mehrfach fehlgeschlagene Bemühungen, den Botanischen Garten an der Doberaner Straße zu erweitern (so unter der Ägide von P. FALKENBERG), führten schließlich während der Amtszeit von H. von GUTTENBERG zur Realisierung einer neuen Anlage an anderer Stelle. 1935-39 wurde im Zusammenwirken mit A. LEHMANN und E. RULSCH als neuer Botanischer Garten das jetzige Freigelände an der Hamburger Straße eingerichtet.

Den Grundstock des Rostocker **Universitätsherbariums** bildet die Privatsammlung von Johannes A. C. ROEPER, der von 1836 bis 1882 als Botanik-Professor in Rostock tätig war. In ihr sind Teile wesentlicher europäischer und außereuropäischer Aufsammlungen des 19. Jahrhunderts enthalten, darunter berühmter Forscher wie Heinrich G. FLÖRKE (Roepers Vorgänger als Lehrstuhlinhaber), L. Adelbert von CHAMISSO oder Ferdinand J. H. von MUELLER. Der wertvollste Teil von Roepers Sammlung - das Herbar LAMARCK - ist allerdings bereits 1886/87 nach Paris verkauft worden.
Der zweite Schwerpunkt des Rostocker Herbariums basiert auf den in Rostock verbliebenen Teilen der Sammlung KRAUSE und wird auch gegenwärtig noch als Mecklenburg-Herbar fortgeführt.
Eine Einzelbeleg-Erfassung über EDV im Rostocker Universitätsherbar ist begonnen worden. Insgesamt enthält es etwa 17.000 Sippen in nahezu 70.000 Belegen.

Die **zoologische Sammlung** der Universität Rostock feierte im Jahre 2000 ihr 225jähriges Bestehen. Sie wurde von dem Orientalisten Professor Dr. Oluf Gerhard TYCHSEN im Jahre 1775 neu gegründet. Ab 1789 war die Sammlung im "Weißen Kolleg" in Rostock untergebracht, nach Übernahme des größten Teils der großherzoglichen Sammlung aus Ludwigslust und Schwerin im "Neuen Museum", schließlich im Gebäude des Landesappellationsgerichts (Universitätsplatz 2), in dem sich heute noch einige Teile befinden.
Schwerpunkte sind Wassertiere, Mollusken, Vögel und Insekten; bei letzteren das Werk des Entomologen Fritz Paul MÜLLER (1913-1989). Bedeutende Belegsammlungen aus der neuesten Zeit betreffen Borstenwürmer (Polychaeta) von Andreas BICK, Fächerflügler (Strepsiptera), Skorpione und Mollusken von Ragnar KINZELBACH und Hans POHL, Fische von Helmut WINKLER.
Daneben sind bedeutende Einzelstücke z. B. der Mecklenburger Pfeilstorch von 1822, ältester materieller Beweis für den Fernzug von Vögeln, oder die durch v. Natterer gesammelte, erstmals von F. H. STANNIUS (1846) in Rostock anatomisch untersuchte südamerikanische Seekuh (Manati).
Die Sammlung ist mit etwa 60.000 Serien ein aktuelles und unentbehrliches Arbeitsmittel für die internationale Biodiversitätsforschung.
(Öffnungszeiten: Führungen (maximale Gruppengröße 16 Personen) in den historischen Sammlungsteil nach Anmeldung Tel. 0381 498 6281 bei Norma Schmitzbach. Für Studierende und Einzelpersonen im Semester freitags 10.15-12.30 Uhr. Ein Ausstellungsraum im Erdgeschoss ist ab 19.04.2002 zugänglich: Mo.-Do. 10.00 bis 16.00)

Die Agrar- und Umweltwissenschaftliche Fakultät

An der Universität Rostock haben aber auch agrarwissenschaftliche Arbeiten eine lange Tradition. 1942 wurde daher eine Landwirtschaftliche Fakultät gegründet, die heute als **Agrar- und Umweltwissenschaftliche Fakultät (AUF)** aus den beiden Fachbereichen Agrarökologie sowie Landeskultur und Umweltschutz besteht und auf deren Gelände die diesjährige Tagung der gtö stattfindet.
Der Fachbereich **Agrarökologie** entstand aus dem 1990 gegründeten Fachbereich Agrarwissenschaften mit einer grundsätzlichen Neugestaltung seines wissenschaftlichen Profils. Lehre und Forschung des Fachbereiches orientieren sich auf die komplexe Entwicklung des ländlichen Raumes und die umweltgerechte Landbewirtschaftung mit aktiver Gestaltung von Agroökosystemen.
Der Fachbereich **Landeskultur und Umweltschutz** kann in der heutigen Form auf eine über 10-jährige Geschichte zurückblicken. Der zum Wintersemester 1990 neu eingerichtete Studiengang basiert auf den Traditionen um die Sektion Meliorationswesen und Pflanzenproduktion. Die kulturtechnische Ausbildung geht auf den 1962 etablierten Diplomstudiengang Meliorationstechnik zurück.

An dieser Stelle sei dem Dekan der AUF, Herrn Prof. Dr. Wolfgang Riedel, sehr herzlich für seine Kooperation und die Bereitstellung der Räumlichkeiten in der Fakultät gedankt.

Hinweise für die Tagungsteilnehmer

Lage des Tagungszentrums/Tagungsbüro

Die zentrale Vortragsveranstaltung der Tagung und die Posterausstellung findet auf dem Gelände der Agrar- und Umweltwissenschaftlichen Fakultät (AUF) im Justus-von-Liebig-Weg statt (s. Übersichtskarte). Das Tagungsbüro befindet sich in Foyer des Großen Hörsaalgebäudes Justus-von-Liebig-Weg 8 (HSL, s. Lageplan S. 10). Das Büro kann im Vorfeld der Tagung unter Tel.: 0381 498-6201, -6204 oder -6205 erreicht werden. Während der Tagung gilt die folgende Rufnummer Tel.: 0172 3077264.
Für kurzfristige Ankündigungen und Änderungen beachten Sie bitte die Hinweise des Tagungsbüros im Foyer.

Verpflegung

Es besteht die Möglichkeit zum Mittagessen in der Mensa (s. Übersichtskarte), die wochentags von 11.15-14.30 Uhr geöffnet hat (ab 14.00 Uhr nur noch ein Speisenangebot). Die Gerichte können individuell zusammengestellt werden. Die Mensa ist vom Hörsaalgebäude aus in ca. 7 Min. zu Fuß zu erreichen. Informationen zum täglichen Speiseangebot finden Sie unter www.studentenwerk-rostock.de. Der Imbiss am Samstag wird durch einen Liefer-Service gebracht und kann in den Räumlichkeiten der Tagung eingenommen werden.
Sowohl im Foyer des Hörsaals, als auch im Bereich der Posterausstellung sind Getränkestände eingerichtet.

Begrüßungsabend

Am Mittwoch, dem 19. Februar findet von 19.30 – 22.00 Uhr im Internationalen Begegnungszenterum der Universität (IBZ Rostock e.V.) ein informeller Begrüßungsabend statt. Das IBZ befindet sich in der Bergstraße 7a (s. Übersichtskarte). Für einen Imbiss und Getränke ist gesorgt.

„Geselliger Abend"

Am Freitag, dem 21. Februar, sind alle Tagungsteilnehmer eingeladen ab 19.30 Uhr an einem gemeinsamen Abendessen und geselligen Beisammensein im Gasthaus „Trotzenburg" mit Wikingeressen teilzunehmen. *Eine Anmeldung ist erforderlich!* Das Gasthaus ist vom Großen Hörsaalgebäude aus ebenfalls in ca. 7 Minuten zu Fuß zu erreichen (s. Übersichtskarte, an der Haltestelle Dr.-Lorenz-Weg links).

Öffentlicher Abendvortrag

Am Donnerstag, 20. Februar ab 20.00 Uhr, findet der Öffentliche Abendvortrag von Prof. Dr. Wilhelm Barthlott zum Thema *„Biodiversität als Herausforderung für Forschung und Politik"* in der Aula des Universitäts-Hauptgebäudes statt (Universitätsplatz 1, s. Übersichtskarte u. Verkehrsverbindungen).

Unterkunft

Informationen zu Unterkünften können über die Tourismus-Zentrale der Stadt eingeholt werden (s. unter wichtige Telefonnummern) oder unter www.rostock.de.

Innerstädtische Verkehrsverbindungen (Stand 7.10.2002)

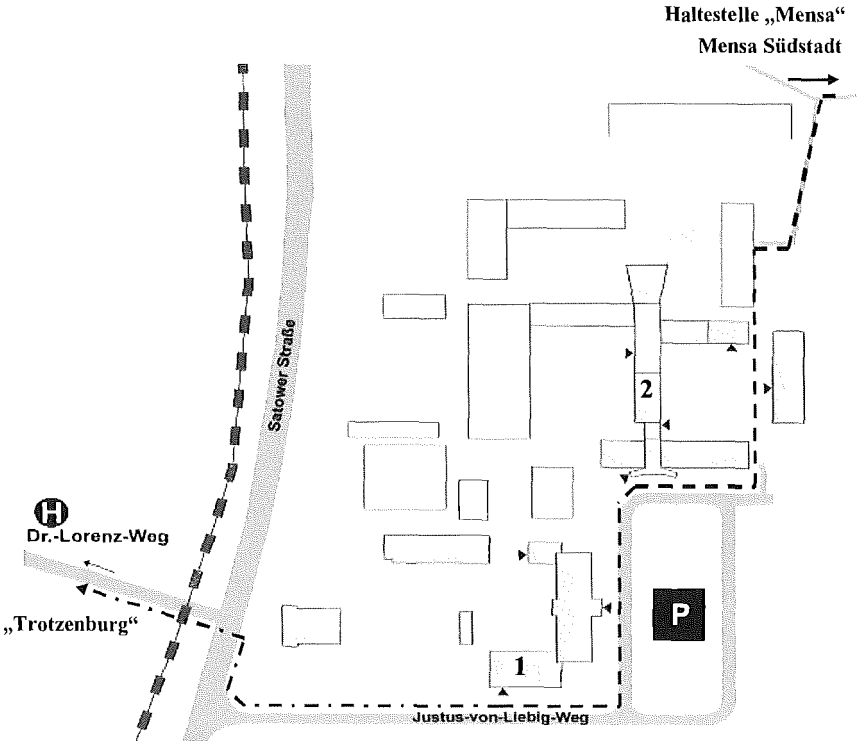
Hauptbahnhof → IBZ
Haltestelle Konrad-Adenauer-Platz (Nordausgang Hbf, s. Übersichtskarte), Bus Linie 25 Richtung Markt Reutershagen, Ausstieg Haltestelle Doberaner Platz.
Tagungszentrum → IBZ
Haltestelle Dr.-Lorenz-Weg, Straßenbahn Linie 11 Richtung Kurt-Schuhmacher-Ring, Ausstieg Haltestelle Doberaner Platz.
Hauptbahnhof ←→ Tagungszentrum (Aus-/Einstieg Haltestelle Mensa)
entweder: Zentraler Omnibus Bahnhof ZOB (Südausgang Hbf, s. Übersichtskarte), Bus Linie 39 Richtung Thomas-Morus-Straße (Gegenrichtung Stadthalle/ZOB).
oder: Vom Hauptbahnhof (Konrad-Adenauer-Platz, s. Übersichtskarte), Bus Linie 23 Richtung Mensa oder Bus Linie 89 Richtung Markt Reutershagen (Gegenrichtung jeweils Riekdahl).
Tagungszentrum → Aula
Haltestelle Dr. Lorenz-Weg, Straßenbahn Linie 11 Richtung Kurt-Schumacher-Ring, Ausstieg Haltestelle Lange Straße (s. Übersichtskarte).

Wichtige Telefonnummern und URLs

Rostocker Straßenbahn AG (RSAG)
Tel.: 0381 8020 oder unter www.rsag-online.de
Taxi
Hanse-Taxi Tel.: 0381 685858 und 659300
Funk Taxi Tel.: 0381 7611176 und 2070707
Tourist-Information
Tel.: 0381 19433 und 0381 381-2222, Fax 0381 381-2601
E-Mail: touristinfo@rostock.de
Auskunft Deutsche Bahn AG:
Tel.: 0800 1507090 oder www.bahn.de
Auskunft InterConnex (Gera – Leipzig – Berlin – Rostock):
Tel.: 01805 101616 oder www.interconnex.com
Flughafen-Information/Service-Center: Tel.: +49 (0) 38454313-39
Fax: + 49 (0) 38454 313-56
E-Mail: Rostock-airport@t-online.de
Apotheken:
Bahnhof-Apotheke
Gerhart-Hauptmann-Str. 28, Tel.: (03 81) 4 92 37 34
Apotheke im Kosmos-Center
Nobelstr. 50b Tel.: (03 81) 4 05 32 20

Lageplan des Tagungsgeländes

(Agrar- und Umweltwissenschaftliche Fakultät)



Legende:

1	Großer Hörsaal (HSL, Justus-von-Liebig-Weg 8) Anmeldung/Tagungsbüro
2	Bereich der Posterausstellung
------	Fußweg zur Mensa Südstadt (Albert-Einstein-Straße)
-.-.-.-	Fußweg Richtung „Trotzenburg“

Eine **Übersichtskarte** finden Sie als Beilage zu diesem Tagungsband.

Dank an die Sponsoren

Die folgenden Firmen und Institutionen haben die Tagung freundlicherweise unterstützt:

Bundesministerium für Bildung und Forschung (BMBF)
Deutsche Forschungsgemeinschaft (DFG)
Deutscher Akademischer Austauschdienst (DAAD)
Deutsche Bank
Buchhandlung Thalia
Buchhandlung Weiland
Computerfachhandel PC-Spezialist
Steigenberger Hotel Sonne

Vielen Dank!

★ ★ ★ ★

STEIGENBERGER

HOTEL SONNE

ROSTOCK

16. Jahrestagung der Gesellschaft für Tropenökologie (gtö)

Universität Rostock, 19. – 22. Februar 2003

Tagungsprogramm

Mittwoch, 19. Februar 2003

15.00 – 19.00	Anreise, Postermontage
19.30 – 22.00	informeller Begrüßungsabend im IBZ

Donnerstag, 20. Februar 2003

08.00 – 09.00	Anmeldung und Postermontage
09.00 – 09.30	Eröffnung der Tagung:
	Prof. Dr. Hans Jürgen Wendel, Rektor der Universität Rostock
	Prof. Dr. Wolfgang Methling, Umweltminister des Landes Mecklenburg-Vorpommern
	Prof. Dr. Stefan Porembski, Institut für Biodiversitätsforschung, Allgemeine und Spezielle Botanik, Organisator der Tagung
	Prof. Dr. Karl Eduard Linsenmair, Präsident der gtö
	Musikbeitrag

→ ***Sektion: Animal - Plant Interaction I (09.30 – 10.30)***

Chairman Prof. Dr. Gerhard Gottsberger

09.30	Swen C. Renner, M. Markussen, M. Mühlenberg, G. Gerold *Bedeutung der Landnutzungsdynamik und Waldentwicklung für die avifaunistische Diversität eines tropischen Bergnebelwaldes Guatemalas*
09.50	E. R. Tirado Herrera, T. Franke, C. Knogge, J. Skrabal, E. W. Heymann *Field observations on the pollinators and seed dispersers of Marcgravia longifolia in Amazonian Peru*
10.10	Fernand-Nestor Tchuenguem, H. B. Tefempa, D. J. Messi, D. Bruckner *Diversity of anthophilous insects of two native plant species, Syzygium guineense var. macrocarpum and Ximenia americana (Olacaceae), in the high altitude savannah of Ngaoundéré (Cameroon)*
10.30 – 11.00	Kaffeepause (30 Min.)

→ ***Sektion: Animal - Plant Interaction II (11.00 – 13.00)***

Chairwoman Prof. Dr. Elisabeth Kalko

11.00 Marco Tschapka
Hovering thieves and perching pollinators: bat pollination of the understory palm Calyptrogyne ghiesbreghtiana

11.20 Karsten Mody, K. E. Linsenmair
Ants influence arthropod community structure but not necessarily herbivory on a myrmecophilic savannah tree

11.40 Britta K. Kunz, K. E. Linsenmair
The role of Olive Baboons on seed dispersal of a West African savanna tree (Parkia biglobosa, Mimosaceae)

12.00 Nico Blüthgen, G. Gebauer, K. Fiedler
Using stable isotopes in a rainforest food web study: ants on plants

12.20 Karl Matthias Wantzen
"Where are the shredders in the tropics?" - aquatic leaf litter decomposition in a global comparison

12.40 Marcell Peters, M. Kraemer
Decrease of a keystone species and predator community shift in East African rainforest fragments

13.00 – 14.15 Mittagspause (1h 15 Min.)

→ 14.15 – 15.00 Plenarvortrag Dr. William F. Laurance
The future of the Amazon

→ ***Sektion: Changes in Land Utilization (15.00 – 16.20)***

Chairman Prof. Dr. Wolfgang Riedel

15.00 Christoph Leuschner, K. Bohman, D. Hölscher, M. Hagemeier
Functional differences between tropical pioneer and late- successional tree species (Sulawesi, Indonesia)

15.20 Ralf Peveling, P. Nagel, B. Sinsin
Conservation of biodiversity in Lama Forest, Benin - role of forest plantations for the viability of natural forests

15.40 Reiner Finkeldey, M. Pandey, O. Gailing, L. Leinemann
Konsequenzen der Anlage von Plantagen für innerartliche Variationsmuster bei tropischen Waldbäumen – Das Beispiel Dalbergia sissoo

16.0 Ingolf Steffan-Dewenter, C. H. Schulze, M. Waltert, P. J. A. Kessler, R. Pitopang, Shahabuddin, D. Veddeler, M. Mühlenberg, S. R. Gradstein, T. Tscharntke
Biodiversity indicator taxa of tropical land-use systems: comparing plants, birds and insects

16.20 – 16.50 Kaffeepause (30 Min.)

→ ***Sektion: Climate Change and Ecosystem Dynamics (16.50 – 17.50)***

Chairman Prof. Dr. Christoph Leuschner

16.50 Martin Freiberg, S. M. Turton
Der Einfluss des Klimas auf die Populationsstruktur des epiphytischen Vogelnestfarnes Asplenium nidus in NO-Queensland, Australien

17.10 Peter Horchler, J. Wesenberg, W. Morawetz
On the unusual long lasting dominance of a pioneer tree species in an Amazonian lowland rain forest

17.30 Gerhard Zotz
Langzeitbeobachtungen an Epiphyten - ein Werkzeug zur Voraussage ihrer zukünftigen Populations- und Gemeinschaftsdynamik

ab 18.00 Posterdemonstration

→ 20.00 Abendvortrag Prof. Dr. Wilhelm Barthlott
Biodiversität als Herausforderung für Forschung und Politik
(Aula der Universität Rostock, Universitätsplatz 1)

Freitag, 21. Februar 2003

Chairman Prof. Dr. Erwin Beck

08.30 Norbert Jürgens
BIOTA Africa - Concepts, first results, and perspectives of an interdisciplinary research initiative

→ ***BIOTA – South (09.00 – 10.20)***

09.00 Bianca Hörsch, M. Vogel, R. Hanatschek, C. Schultz
The potential of remote sensing and GIS for biodiversity monitoring in southern Africa

09.20 Luciana Zedda, B. Büdel, K. Deutschewitz, S. Dojani, T. Feuerer, C. Görke, A. Gröngröft, K. Loris, A. Petersen, F. Oberwinkler, G. Rambold, W. Reisser, M. Salisch, E. Uhlmann, B. Weber, V. Wirth
Biodiversity gradients in soil-inhabitant fungal and algal associations along the BIOTA transect in southern Africa

09.40 Ulrich Zeller, J. Deckert, S. Eiseb, J. Frisch, P. Giere, A. Hoffmann, F. Koch, E. Marais, W. Mey, C. Muck, J. Plötner, M. Uhlig, K. Vohland, H. Wendt
Biodiversity Research: aspects linked to the diversity of small mammals and arthropods along a southern African transect - preliminary results of BIOTA S07

10.00 Ernst-August Nuppenau
Results from socio-economic investigations of BIOTA

10.20 – 10.50 Kaffeepause (30 Min.)

→ ***BIOTA – West (10.50 – 12.10)***

Chairman Prof. Dr. Siegmar Breckle

10.50 Jörg Szarzynski, B. Hörsch, T. Brou Yao
Climate variability and land cover dynamics in Côte d'Ivoire as crucial aspects for terrestrial biodiversity. Methods and first results of an integrative monitoring approach

11.10 Dethardt Goetze, K. König, B. Hörsch, K. Hahn-Hadjali, S. Porembski
Historical developments of landscape patterns and phytodiversity in protected and utilized areas of Burkina Faso and Ivory Coast

11.30 Njikoha M. Ebigbo, J. Fahr, E. K. V. Kalko
The role of flying foxes on the vegetation dynamics of Cola cordifolia (Sterculiaceae)

11.50 Mark-Oliver Rödel, M. Veith, K. E. Linsenmair
Pristine versus altered: how do frogs cope?

→ ***BIOTA – East (12.10 – 13.30)***

12.10 Bärbel Bleher, G. Schaab, K. Böhning-Gaese
Man, birds and berries – human impact on forests and plant-animal-interactions

12.30 Michael Veith, J. Kosuch, S. Lötters, M.-O. Rödel
Small genes for big problems – coping with challenges in afrotropical amphibian diversity

12.50 Viola Clausnitzer, A. Martens, F. Suhling
From desert to forest: diversity of African Odonata

13.10 Christoph Oberprieler, N. Kilian, H. Kürschner, B. Mies, C. M. Naumann, M. A. Hubaishan, A. K. Nashr, P. Hein, C. Klütsch, J. Meister, K. Rabe
Habitat fragmentation in southern Arabia: xerotropical ecosystems at their outer limits

13.30 – 14.45 Mittagspause (1h 15 Min.)

→ 14.45 – 15.30 Plenarvortrag Prof. Dr. Brice Sinsin
Change in soil conditions and life forms with plant community dynamics in a savanna landscape

→ ***Sektion: Freie Themen I (15.30 – 17.10)***

Chairman Prof. Dr. Norbert Jürgens

15.30 Johannes Refisch, I. Koné
The effects of market hunting on monkey populations in the Taï National Park, Côte d'Ivoire

15.50 Axel Hochkirch
Differenzierung flugunfähiger Heuschrecken im ostafrikanischen Bergbogen

16.10	Wolfgang Küper, H. Kreft, J. Nieder, H. Sommer, W. Barthlott *Diversity and biogeography of neotropical epiphytes - how geographical ranges, endemism and species richness of epiphytes in the Andes change with altitude*
16.30	Burkhard Büdel, S. Dojani, M. Kühl, M. Lakatos, U. Rascher, B. Weber, D. C. J. Wessels *Diversity and ecological impact of biological crusts in tropical/subtropical biomes*
16.50	Rainer Steinbrecher, W. Junkermann, R. Zuurbier, D. Steigner, B. Rappengleuck, J. Burger, G. Schaab *Biodiversity of the Kakamega Forest in Kenya and the impact of increasing pressure through population: a new technique for assessing area averaged change in trace gas exchange between ecosystems and the atmosphere*
17.15	16. Mitgliederversammlung der gtö und Posterdemonstration
ab 19.30	Gemeinsames Abendessen und geselliges Beisammensein im Gasthaus „Trotzenburg“

Samstag, 22. Februar 2003

→ ***Sektion: Fragmentation and Habitat Islands (08.30 – 09.50)***

Chairman Prof. Dr. Stephan Robbert Gradstein

08.30	Jutta Schmid *Effects of forest fragmentation on the physiology and population characteristics of grey mouse lemurs in littoral forests of southeastern Madagascar*
08.50	Gerhard Gerold , J.- P. Krüger *Entwicklung und Prognose der Waldkonversion für die Fragmentierung der Waldökosysteme in Ostbolivien*
09.10	Pille Urbas, W. R. Almeida, V. Barbosa, P. F. Falcão, C. M. Knoechelmann, Ú. A. Silveira, M. A. Vieira-Jr., I. R. Leal, R. Wirth *Increase of leaf-cutting ant density through forest fragmentation: a result of altered trophic structure*
09.30	Kathrin H. Dausmann *The effects of fragmentation on seed dispersal and seed predation in a dry deciduous forest in western Madagascar*
09.50 – 10.20	Kaffeepause (30 Min.)

→ ***Sektion Regeneration of Ecosystems (10.20 – 12.40)***

Chairman Prof. Dr. Reinhard Lieberei

10.20 Christoph Reisdorff, R. Lieberei
Aspects of ecological functionality in agroforestry systems counteracting pedoclimatic constraints in the central Amazon

10.40 Marian Kazda, K. Heinen, J. Salzer
Unterschiedliche Strategien der Raumbesetzung bei Lianen und Bäumen in verschiedenen tropischen Ökosystemen

11.00 Marion Schrumpf, J. Axmacher, H. Tünte, K. Müller-Hohenstein, W. Zech
Bergwaldregeneration am Mt. Kilimanjaro, Tanzania: Synthese von Biodiversitätsdynamik und Nährstoffdynamik

11.20 Shao-lin Peng
Development of species diversity in the restoration process of establishing a tropical man-made forest ecosystem in China

11.40 Manfred Finckh, M. Staudinger
Beitrag zur Vegetationsdynamik der Igelpolsterheiden des Hohen Atlas, Marokko

12.00 Sven Günter, R. Mosandl
Natural Forest Management in Bergregenwäldern Südecuadors - Eine Option zur Erhaltung von Biodiversität?

12.20 Detlev Paulsch, K. Müller-Hohenstein
Vogelgemeinschaften in südecuadorianischen Bergregenwäldern unterschiedlicher Struktur

12.40 – 13.10 Imbiss (30 Min.)

→ ***Sektion: Freie Themen II (13.10 – 15.30)***

Chairman Prof. Dr. Ragnar Kinzelbach

13.10 Moses N. Sainge
Studies on the phenology of African myco-heterotrophic plants

13.30 Peter Leins, C. Erbar
The pollen box in Cyphiaceae (Campanulales)

13.50 Joanna Fietz
Preparations for and consequences of hibernation in the tropics, a comparison between a tropical and temperate hibernator: Cheirogaleus medius - Glis glis

14.10 Jürgen Homeier, S.-W. Breckle
Wachstum und Phänologie einiger häufiger Baumarten im südecuadorianischen Bergregenwald

14.30	Bettina Orthmann, S. Porembski *Impact of selective logging of four tree species on natural tree regeneration in different woodlands (Benin, West Africa)*
14.50	Hendrik Freitag *Longitudinale Zonierung von Crustaceenzönosen zweier Flusssysteme auf Palawan, Philippinen*
15.10	Wolfgang Wilcke, J. Boy, R. Goller, K. Fleischbein, C. Valarezo, W. Zech *Spurenelement-Haushalt eines ecuadorianischen Bergregenwaldökosystems - gibt es Hinweise auf Mangel?*
15.30	Helmut Dalitz *Kleinräumige Heterogenität - ein Diversitäts-generierender Faktor?*
15.50	Verleihung des Merian-Preises für den besten Vortrag und das beste Poster
16.00	Tagungsende

Samstagabend/Sonntag

Es besteht die Möglichkeit nach Absprache mit ev. verbleibenden Personen und kurzfristiger Organisation einen Tag in und um Rostock zu gestalten (bitte wenden Sie sich in einem solchen Fall an das Tagungsbüro).

Abstracts des öffentlichen Abendvortrags und der Plenarvorträge

Biodiversity – a challenge for research and policy

Wilhelm Barthlott

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Biodiversity is an essential good for the existence of mankind depending on food, material resources and the elementary functions of ecosystems.
Considering this importance, our current knowledge is out of all proportion-especially because human activities have a drastic and increasing effect on biodiversity. Before we ever have understood essential mechanisms or won reliable information even on its order of magnitude, biodiversity is subjected to dramatic change.
The sustainable use and protection of biodiversity requires reliable information about its quality, the mechanisms of its evolution and especially its geographical distribution.
In these respects, vascular plants can serve as an indicator group, because of their ecological significance and our comparatively advanced knowledge on their diversity. Analyses include the various qualities of biodiversity (e.g. species richness, endemism) and the differing geographical concentrations of taxonomic and ecological subgroups.
Scientists work, such as the delimitation and analysis of centers of species richness, should consider the impact of socioeconomic dynamics and global change in order to identify areas with conservation conflicts. This is the base for the development of appropriate conservation strategies *in situ* (e.g. the priorisation of areas for conservation) or *ex situ* (e.g. in an international cooperative network of Botanical Gardens). The success of both depends on an implementation of conservational aspects in political decisions and is therefore a cooperative challenge for science and politics.

The future of the Amazon

William F. Laurance

Smithsonian Tropical Research Institute
Apartado 2072, Balboa, Republic of Panama

The Amazon basin has the world's highest absolute rate of deforestation and is facing unprecedented threats from new highways and infrastructure development, forest-colonization projects and ranching, and rapidly growing timber and mining industries. I summarize key trends in Amazonian development, then describe an effort to project the future condition of the region's forests, using a geographic information system that incorporates many relevant biophysical and anthropogenic factors. Results of the analyses suggest that Amazonian forests will be dramatically transformed by the year 2020, if most projects planned for the region proceed. Rates of forest loss and degradation are likely to increase sharply, and large expanses of the basin will be fragmented into isolated forest tracts that will be increasingly vulnerable to fires, predatory logging, and other degrading activities.

Change in soil conditions and life forms with plan community dynamics in a savanna landscape

Brice Sinsin

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01 BP 526 Cotonou, Bénin

Landscape covered by savannas occurred mainly subhumid zones where basic land utilisation concerns agriculture and pastoralism. These two anthropogenic uses are driving forces for the evolution of plant communities in sudanian region. As in many other areas in the sudanian phytochory where savanna landscape is common, plant communities are found to house a high diversity of associations well more defined by the herbaceous strata. Phytosociological analysies of plant communities on plateau and in depression allowed to identify 8 associations occurring in fields, fallows and savannas. The serial relationship linking one stage to the other was established with major soil properties, life form occurrence in association, and phytogeographical types. Hemicryptophyte species was the most discriminating life form that matches well with changing stages. According to topography serial evolution showed more variation in plant communities on plateau through dominance of stage pattern than in depression. On both plateau and depression, phytogeographical type evolution marked a decreasing abundance of those species occurring at large geographical scale from earlier stage to more mature one. This trend in phytogeographical type indicates a specialisation of the flora to local environment through evolution. Soil organic matter showed non linear evolution during fallow stages on plateau indicating that traditional soil restoration with fallow practice needs to be well acknowledged.

Key word: evolution, hemicryptophyte, phytogeographical type, soil condition, association, Benin

Abstracts der Vorträge

API – Animal-Plant-Interactions
LU – Changes in Land Utilization
CC/ED – Climate Change and Ecosystem Dynamics
BS – BIOTA South
BW – BIOTA West
BO – BIOTA East
FHI – Fragmentation and Habitat Islands
RE – Regeneration of Ecosystems
FT – Freie Themen

BE

Man, birds and berries – human impact on forests and plant-animal-interactions

Bärbel Bleher[1,2], Gertrud Schaab[3] & Katrin Böhning-Gaese[1,2]

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In the current worldwide biodiversity crisis human impact such as habitat fragmentation and degradation is the major thread to forests especially to tropical forest ecosystems. These changes in forest cover have important consequences not only for biodiversity but also for related ecosystem processes. Here we present two BIOTA-East projects investigating the consequences of human impact on forest cover over time using remote sensing data (E02) and on avian diversity, seed dispersal and forest regeneration (E11) in Kakamega Forest, Western Kenya.

In order to extrapolate field data over time and space, a homogenuous and dense time series on land cover change is needed. Landsat imagery turned out to be an ideal data basis. It allows to look back in time over the last 30 years. A threshold analysis of the green channel for imagery of 7 different years between 1972 and 2001 resulted in a first preliminary time series on forest cover change for the Kakamega Forest area. Spatial changes like major forest losses as well as plantations are revealed by visualising the time slices that distinguish between „forest" and „no forest". The subsequent integration of these data layers into the BIOTA-East GIS and thus the availability of GIS functionalities enables further analyses. Here, exact numbers of forest areas and their changes over time have been derived for the separately investigated forest areas and fragments.

These data on forest cover are an important background for further investigations on biodiversity and processes at the interface of seed dispersal and forest regeneration. At this interface we monitor all involved interactions partners such as animal dispersers (birds, primates and mammals) and fruit resources (trees, shrubs and lianas) comparatively in continuous forest and forest fragments. First results show lower bird species numbers and regenerating seedling species numbers in fragments and sites managed by Forest Department as compared to continuous forest and Kenyan Wildlife Service sites indicating an influence of fragmentation and human disturbance. Furthermore, the processes of seed dispersal, seed predation and seedling establishment is investigated in-depth in selected tree species (e.g. *Prunus africana, Antiaris toxicaria, Ficus* spp.). First results with *Ficus* spp. indicate differences in frugivore assemblages visiting the trees between continuous forest and forest fragments. Only combined efforts using remote sensing data and field observations on various ecological levels can efficiently assess the impact of fragmentation and human disturbance on forests at spatial and time scales necessary to develop relevant management decisions.

API

Using stable isotopes in a rainforest food web study: ants on plants

Nico Blüthgen[1], Gerhard Gebauer[2] & Konrad Fiedler[1]

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Stable isotope analysis is applied to a growing number of food webs, especially where direct observations may fail to reliably quantify resource use. Investigations on complex and mobile tropical insect communities are very scant thus far. For rainforest ant communities, the extent of direct consumption of plant-derived resources vs. predation is largely unknown. However, determination of the extent of 'herbivory' among ants may be crucial to understand the hyper-dominance of ants in tropical tree crowns, where prey organisms tend to occur scarcely and unpredictably. We therefore examined the natural abundance of heavy nitrogen and carbon isotopes ($\delta^{15}N$ and $\delta^{13}C$) in 50 ant species and associated insects and plants from a tropical rainforest in North Queensland, Australia.

Variation between ant species was pronounced (range of species means: 7.1‰ in $\delta^{15}N$ and 6.8‰ in $\delta^{13}C$). Isotope signatures of the ant community overlapped with several herbivorous and predacious arthropods. Ant species were found in a continuum between largely herbivorous and purely predacious taxa, with a high degree of omnivory.

Ant species assignments to different trophic levels according to $\delta^{15}N$ correspond well with direct observations of their feeding behaviour. The results confirm that nectar and honeydew sources play an important role in the nitrogen and carbon budget of many ant species foraging in the canopy and on understorey plants, while predation is more important for species that mainly forage on the ground. Whether or not an ant species was observed on nectar sources was a significant predictor of the trophic level indicated by $\delta^{15}N$, but not by $\delta^{13}C$ (ANOVA). On a finer scale, however, the absolute frequency of nectar plant visits (when total abundance of these ants is not taken into account) was not significantly correlated with either $\delta^{15}N$ or $\delta^{13}C$. Ant species that were associated with honeydew-producing homopterans besides feeding on nectar had intermediate trophic positions and did not differ significantly from other nectar feeding ants.

Besides clear interspecific differences in isotope signatures, plasticity between conspecific ant colonies was non-negligible. Colonies of omnivorous weaver-ants (*Oecophylla smaragdina*) showed significantly lower $\delta^{15}N$ in mature forests (where preferred honeydew and nectar sources are abundant) than in open secondary vegetation.

Plant leaves collected from 26 common tree and liana species had isotopic signatures typical for other tropical forests, showed no indication of CAM and C_4 photosynthesis, and generally low ^{15}N abundance. Ant-tended homopterans showed a variable isotopic shift compared to their host plant tissue; membracids and cicadellids were more enriched in ^{13}C, while coccoids and aphids were more so in ^{15}N. A small increase of ^{15}N was found from ant larvae to adult workers, and between major and minor workers from the same colony. This study demonstrates that stable isotopes provide a powerful tool for quantitative analyses of trophic niche partitioning and plasticity in complex and diverse tropical omnivore communities.

FT

Diversity and ecological impact of biological crusts in tropical/subtropical biomes

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Biological crusts (bc's) consist of bacteria, cyanobacteria, algae, microfungi, lichens and more rarely, mosses. Only in rare cases all organismic components are represented in such a crust. However, cyanobacteria always belong to the basic inventory of crusts.
Bc's can be found worldwide on open, exposed rock surfaces and on/in soils of arid and semi-arid regions or wherever an arid microclimate exists. They cover large areas of the world and thus contribute to the referring ecosystems biomasses as well as to carbon and nitrogen turn-over.
Several types are distinguished and their species composition largely influences carbon gain and di-nitrogen fixation of the crust. Several examples of different bc's (soil crusts, rock crusts, climax crusts and pioneer crusts) will be demonstrated in this lecture. Their diversity and ecology shall be discussed, including influence on diversity of phanerogamous plants and the geomorphological consequences of selected regions.

BE

From desert to forest: diversity of African Odonata

Viola Clausnitzer (E07), Andreas Martens (S08), Frank Suhling (S08)

The two dragonfly projects of BIOTA (BIOdiversity Transect Analysis in Africa; E07 and S08) work on diversity patterns of dragonflies in eastern and southwest Africa. Main topics of the joined studies are the effects of habitat fragmentation on species composition and genetic isolation, changes in diversity patterns along natural and anthropological gradients and adaptations to seasonal habitat conditions. Results of these studies are used to define indicator species and monitoring programmes for habitat quality and rapid assessments.
Nearly all species found in Namibia are common in savannah habitats in East Africa and even West Africa as well. Most of these species are migratory and colonise seasonal wetlands even in an otherwise very dry matrix (temporal and spatial). The genetic variation between East and Southwest African populations of such species, e.g. *Crocothemis erytrea* or *Trithemis kirby* is very small. Species with adaptations to distinct habitats, e.g. forests or spring brooks on the other hand show genetic differences between isolated populations. *Coryphagrion grandis*, which occurs in the fragmented coastal forest regions of East Africa, shows high sequence diversity between populations, which correlates with the distance and therefore age of the single forest fragments.
Our results from the BIOTA transect from east to southwest Africa allow biogeographic discussions about past and present distribution patterns of dragonflies and about shifts in biodiversity patterns with changing climatic and/or environmental conditions. Results of both projects also indicate that Odonata are good indicators for assessing anthropogenic impacts on inland waters.

FT

Kleinräumige Heterogenität – ein Diversitäts-generierender Faktor ?

Helmut Dalitz

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Thema: Kleinräumige Heterogenität, Bodenparameter, Bestandesniederschlag

In drei verschiedenen Waldökosytemen der Tropen (Costa Rica, Ecuador, Kenia) wurden Daten zur kleinräumigen Heterogenität des Bestandesniederschlages, der Bodennährstoff-gehalte und der Kronenstruktur erhoben. Die ersten Ergebnisse zeigen sowohl hinsichtlich des Volumens als auch der Nährelementflüsse im Bestandesniederschlag eine hohe kleinräumige Heterogenität auf den Untersuchungsflächen. Ähnliches gilt für die Bodennährstoffgehalte und die Kronenstuktur. Es stellt sich daher die Frage, inwieweit diese räumlich heterogenen Muster einen Einfluss auf die Regeneration im Bestand (nicht in Gaps) haben und wie dieser Einfluss gemessen und bewertet werden kann.

FHI

The effects of fragmentation on seed dispersal and seed predation in a dry deciduous forest in Western Madagascar

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Present address: Department of Animal Physiology, University of Marburg, Germany

Besides the immediate negative effects of intensive logging on biological diversity, species might also be lost more gradually through fragmentation of remaining forests into isolated forest islands. This fragmentation of habitat can intervene in the ecological interactions between plants and animals in numerous ways and throw the ecological system off balance.
The objective of this study was to examine experimentally how fragmentation of the Malagasy dry forest into small isolated patches influences the fate of seeds after primary dispersal in a lemur dispersed tree species (*Strychnos madagascariensis*). We assessed, how possible changes in these processes alter the regeneration dynamics of this trees in the forest fragments. By using size-selective exclosures, we investigated how the processes of secondary seed dispersal and post-dispersal seed predation are altered in forest fragments, where primary seed dispersers and seed predators are absent, in comparison to the continuous forest, where they are numerous. Furthermore we checked, if proposed changes are reflected in the patterns of regeneration and establishment of *S. madagascariensis* in the forest fragments.
In the continuous forest up to 100 % of the seeds were removed within the seven days of our experiments, a substantial proportion of them being lost to post-dispersal seed predation by rodents (*Hypogeomys antimena*, *Eliurus myoxinus*). In the forest fragment, on the contrary, practically no predation took place and almost all seeds removed were secondarily dispersed into the safety of ant nests (*Aphaenogaster swammerdami*) with improved chances of establishment. In agreement with these findings, the abundances of *S. madagascariensis* in the forest fragments exceeded those of the continuos forest in all investigated age classes.
The result of this study make it clear, that the processes of ecological interactions like seed dispersal and seed predation can be altered by fragmentation and can lead to an impoverished forest community.
This study was financially supported by the DFG (Ga 342/3-2)

BW

The role of flying foxes on the vegetation dynamics of Cola cordifolia (Sterculiaceae)

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Bats, in the Old World Megachiroptera (flying foxes) and Microchiroptera (insectivorous bats), are ecologically among the most diverse groups of vertebrates due to their high species richness, biomass, and trophic diversity. They play key roles as seed dispersers, pollinators, and predators and serve as critical links in important ecological processes such as regeneration, and nutrient cycling.

We test the proposition that flying foxes are important seed dispersers because of their frugivorous diet, high mobility, and high local abundance. We hypothesize that flying foxes act as efficient and effective seed dispersers that strongly influence local vegetation dynamics, in particular island and gallery forests. We ask how feeding behaviour, in particular fruit removal from parent trees, affects the distribution of seeds. We further investigate how this process enhances germination and establishment success of the seedlings. These questions are investigated in a dispersal system involving the focal tree species *Cola cordifolia* (Sterculiaceae), which is locally dominant in island forests.

We conduct our studies within the framework of the BIOTA West Africa project in the forest-savannah mosaic of the Comoé-N.P. Data collection takes place, in direct cooperation with other BIOTA subprojects W04 (botany) and W01 (climatology), in permanent study plots. We intensively search two island forests for seed deposition sites (feeding roosts) of flying foxes and map them with the aid of a differential GPS system with an accuracy of 10 – 50 cm. Seed rain and seed shadows are determined with ca. 150 seed- and fruit traps placed along the savannah-forest gradient of the two island forests. In cooperation with the project partners, 450 seedlings of *Cola cordifolia* were transplanted along the ecological gradient between savannah and island forest. We controlled establishment success of the seedlings from September 2001 to August 2002 with continuous measurements of environmental parameters encompassing vegetation structure and microclimate. In addition, we measured seed removal and germination rate of seeds at feeding roosts used by flying foxes as well as the temporal and spatial distribution of age classes of *Cola cordifolia* in selected forest islands.

We found that flying foxes contribute substantially to seed dispersal because they do not consume fruits in the respective trees but carry them away in flight and process them at temporary feeding roosts without harming the seeds. Seeds were not ingested and were deposited at various distances from parent trees in areas with low adult tree densities of the focal species *C. cordifolia*. Seedling density was high under parent trees as well as under feeding roosts. Seedlings were aggregated over a large area under parent trees in contrast to feeding roosts where aggregation was limited to a small area just under the roost. Seed germination, which occurred during the rainy season, was high. Our results show clearly that during the rainy season relative growth rate of planted *C. cordifolia* seedlings was similar irrespective of where they were planted. This was also true for mortality rate, which was also independent of the position of seedlings in the transect, up to the end of the dry season in both burned and unburned plots. At the end of the investigation period only one individual survived in an unburned plot.

The majority of successfully established *C. cordifolia* saplings were found in areas with low densities of adult trees of the same species. We conclude that dispersal away from the parent tree contributes substantially to successful establishment. We verified this by comparing the spatial distribution of seeds with adults and saplings in two different island forests using computed seed dispersal kernels as well as point pattern analysis.

FT

Preparations for and consequences of hibernation in the tropics, a comparison between a tropical and temperate hibernator: *Cheirogaleus medius - Glis glis*

Joanna Fietz

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In temperate species hibernation is enhanced by high levels of essential fatty acids (EFAs) in their white adipose tissue (WAT). EFAs cannot be synthesized by mammals, thus nutritional ecology should play a key role in adaptations to hibernation physiology. Tropical hibernators are exposed to different physiological demands than hibernators in temperate regions and are expected to be subject to different constraints. Aims of this study were to elucidate ecological and physiological limitations of hibernation physiology under different climatic conditions. *Cheirogaleus medius* (Primates) and *Glis glis* (Rodentia) are both obligate hibernators that occupy comparable ecological niches, *C. medius* in the tropics, *G. glis* in temperate zones. This comparative field study was conducted in Western Madagascar and Southwest Germany between 2000 and 2001. A capture-recapture study was combined with feeding observations or fecal analyses in Western Madagascar and Southwest Germany. Dietary items and samples of WAT prior to and after hibernation were collected of both species and analyzed for their fatty acid pattern.

Results of this study reveal that during pre-hibernation fattening the temperate edible dormouse (*G. glis*) feeds mainly on fruits with high lipid and EFA contents. The fatty acid pattern of the diet is reflected in its WAT, which contains up to 45 % of EFAs before the onset of hibernation. During hibernation, EFAs are selectively mobilized and serve as main fuel in the edible dormouse.

In contrast to temperate hibernators, the fat-tailed dwarf lemur (*C. medius*) exhibits extremely low EFA concentrations in its white adipose tissue (2.5 %) prior to hibernation. During pre-hibernation fattening the fat-tailed dwarf lemur prefers fruits with extremely high sugar content and synthesizes preferentially mono unsaturated fatty acids from these dietary carbohydrates. As a consequence the fatty acid pattern of the WAT does not reflect dietary fatty acid composition. Due to its prevalence, the main fuel during hibernation is the mono unsaturated oleic acid. Results suggest that in contrast to temperate hibernators like the edible dormouse, EFAs do not represent a limitation for hibernation in the tropics, at least not in the fat-tailed dwarf lemur.

The study was financed by the Deutsche Forschungsgemeinschaft (FI 831/1-1; FI 831/1-2).

RE

Beitrag zur Vegetationsdynamik der Igelpolsterheiden des Hohen Atlas, Marokko

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Von kugelwüchsigen Dornsträuchern geprägte Vegetationseinheiten finden sich weit verbreitet in den Gebirgen des südlichen Mittelmeergebietes. Während die morphologischen Anpassungen und auffälligen konvergenten Entwicklungen der Igelpolsterarten bereits früh wissenschaftliche Aufmerksamkeit erregten, ist bis heute relativ wenig über die standörtliche Differenzierung und Regenerationsdynamik dieser oromediterranen Vegetationseinheiten bekannt. Im Rahmen des Impetus-Projekts wird nun im südmarokkanischen Draa-Einzugsgebiet der Versuch unternommen, die standörtliche Differenzierung und die Regenerationsdynamik der dortigen *Erinacetalia*-Gesellschaften zu analysieren.
Untersucht wird dabei anhand von Vegetationsaufnahmen die geographische und standörtliche Verbreitung wichtiger aufbauender Arten. Auf 5 Dauerbeobachtungsflächen an zwei Impetus-Testsites wird zum einen mit Loggermessungen die mikroklimatische Funktion der kugeligen Wuchsform von *Alyssum spinosum*, *Astragalus ibrahimianus*, *Bupleurum spinosum*, *Cytisus balansae*, *Erinacea anthyllis* und *Vella mairei* im Vergleich zum Freilandklima untersucht. Zum anderen werden hier am Beispiel von *Alyssum spinosum* die aktuellen Bestandesstrukturen mit dem räumlichen Verteilungsmuster der Keimlinge verglichen. Der Beweidungseinfluß auf das Regenerationsverhalten wird durch den Vergleich gezäunter und ungezäunter Flächen abgeschätzt. Abschliessend werden die Ergebnisse der Vegetationsaufnahmen, der Dauerbeobachtungsflächen und der mikroklimatischen Untersuchungen gemeinsam diskutiert.

LU

Konsequenzen der Anlage von Plantagen für innerartliche Variationsmuster bei tropischen Waldbäumen – Das Beispiel *Dalbergia sissoo*

Reiner Finkeldey, Madhav Pandey, Oliver Gailing und Ludger Leinemann

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Die Produktion von Holz und anderen Produkten des Waldes kann in Anbetracht einer wachsenden Bevölkerung in tropischen Ländern nur gesichert werden, wenn neben einer nachhaltigen Naturwaldbewirtschaftung auch Plantagen durch künstliche Begründung, also Pflanzung oder Saat, angelegt werden. Plantagen wurden auch in den Tropen bereits für viele Baumarten angelegt. Der Ursprung des Materials, welches zur ihrer Anlage genutzt wurde, ist aber häufig unbekannt. Ein ungeeigneter Ursprung kann zu schlechter Angepasstheit oder geringer Anpassungsfähigkeit der künstlich begründeten Bestände führen.
Wir haben genetische Variationsmuster bei der südasiatischen Baumart *Dalbergia sissoo* in Nepal sowohl in fünf natürlichen Beständen als auch in fünf jeweils benachbarten Plantagen unbekannten Ursprungs untersucht. Die Analyse der Variationsmuster maternal vererbter cp-Haplotypen zeigt, dass in keinem Fall die untersuchten Naturwälder als Ursprung von einer Plantage in Frage kommen. Es muß vielmehr von weiträumigem Saatguttransfer vermutlich aus anderen Ländern (Indien) vor der Begründung der Plantagen ausgegangen werden. An einem biparental vererbten Isoenzym-Genort erwiesen sich alle Plantagen als monomorph, während in allen Naturwäldern Variation beobachtet wurde. Die unterschiedliche Vergangenheit von Plantagen und natürlichen Beständen spiegelt sich also in differierenden genetischen Strukturen und damit vermutlich auch in differierenden Anpassungspotenzialen wider. Unser Beispiel zeigt, dass weiträumiger, unkontrollierter Saatguttransfer gravierende Konsequenzen für innerartliche Variationsmuster und Anpassungspotenziale bei tropischen Waldbäumen haben kann.

CC/ED

Der Einfluss des Klimas auf die Populationsstruktur des epiphytischen Vogelnestfarnes, *Asplenium nidus* in Nordost-Queensland, Australien

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Die globalen Klimaperioden of El Nino und La Nina des Southern Oscillation Index (SOI) beeinflussen die natürliche Überlebensrate und die Etablierung der Vegetation in vielen Teilen der Welt und besonders der südwestlichen Pazifikregion. Nordost Queensland, Australien, liegt inmitten dieser Region und wird überdies regelmäßig von tropischen Wirbelstürmen heimgesucht. Die Frage die hier analysiert wurde war, ob Trockenperioden dieser Zyklen stark genug sind, um die Überlebensrate von Epiphyten in den Resten des tropischen Tieflandregenwaldes dieser Region entscheidend zu beeinflussen und welche Auswirkungen die zu erwartenden, noch trockeneren Perioden aufgrund des global warming haben könnten.

Dazu wurde die Ökologie des holoepiphytischen *Asplenium nidus* und seine Reaktion auf Trockenstress unter natürlichen Bedingungen in Cape Tribulation, Nordost Queensland, genauer untersucht. In einem Experiment wurde ein von zwei unmittelbar benachbarten, gleichaltrigen Farnen in der Trockenzeit künstlich bewässert. Das Mikroklima innerhalb und in der Umgebung beider Farne wurde über eine Periode von acht Monaten dokumentiert und festgestellt, dass eine Periode über sechs Wochen ohne jeglichen Regen ausreicht, um das gespeicherte Wasser des nicht begossenen Nestfarnes komplett zu verlieren. Noch längere Perioden führen zum Absturz der Pflanzen, da die Haftwurzeln absterben. Perioden über 12 Wochen töten schließlich die noch in den Astgabeln der Baumkronen verbliebenen Pflanzen.

Durch die komplette Analyse aller Pflanzen des 1 ha Kranplottes in Cape Tribulation, inklusive ihrer Altersbestimmung, konnte die Populationsstruktur des Farnes für diesen Bestand historisch überprüft und interpretiert werden.

FT

Longitudinale Zonierung von Crustaceenzönosen zweier Flusssysteme auf Palawan, Philippinen

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Über den Zeitraum von einem Jahr wurden auf der tropischen Insel Palawan (Sundaschelf) benthische Crustaceenzönosen im Süß- und Brackwasser mittels exponierten Substratkörben, Driftnetzen und weiteren Fangmethoden beprobt. Der im St.-Paul-Nationalpark gelegene Cabayugan River wurde dabei abschnittsweise über den gesamten longitudinalen Verlauf bis zum Estuar untersucht. Besondere Beachtung fand eine unterirdischer Fliessstrecke, sowie ein Flussabschnitt in einer besiedelten, landwirtschaftlich genutzten Ebene. Ein weiterer Flusslauf vergleichbarer Größe wurde als Referenzgewässer an 2 Stellen beprobt.
Die vorgefundenen Zönosen setzten sich aus zahlreichen Caridea-Arten überwiegend der Gattungen *Macrobrachium* und *Caridina* zusammen, die teils mit wechselnden Repräsentanten im Longitudinalverlauf vertreten waren. Unter den Brachyura fanden sich im salzwasserbeeinflussten Bereich die Gattungen *Parapyxidognathus, Ptychognathus, Utica* und *Varuna*, während Mittel- und Oberläufe von einer *Parathelphusa sp.* dominiert wurden. Isopoden wurden in geringer Anzahl im gesamten Längsverlauf nachgewiesen. Amphipoden traten in z. T. hohen Abundanzen im Estuar- und subterranen Bereich auf, wie auch mehrere Alpheiden-Arten (Caridea) und *Coenobita sp.* (Anomura).
Die faunistischen Daten werden anhand der Landnutzung, Gewässermorphologie, sowie physikalischen und biochemischen Messwerten ökologisch interpretiert.

FHI

Entwicklung und Prognose der Waldkonversion für die Fragmentierung der Waldökosysteme in Ostbolivien

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Das östliche bolivianische Tiefland besitzt weltweit noch mit die größten Gebiete tropischer Trockenwälder (KILLEEN & SCHULENBERG 1999). Die Region liegt in einer Übergangszone zwischen den feuchttropischen Wäldern des Amazonas, dem Cerrado-Savannen Komplex und den Dornbuschwäldern des Gran Chaco. Das Zusammentreffen der verschiedenen biogeographischen Zonen hat in Ostbolivien ein weites Spektrum laubabwerfender Wälder (halbimmergrüne tropische Wälder, Chacotrockenwälder), sowie Savannenkomplexe und Feuchtgebiete mit einer enormen biologischen Vielfalt entstehen lassen (MYERS et al. 2000).
In den letzten drei Dekaden vollzieht sich östlich der Departmenthauptstadt Santa Cruz ein stetiger Anstieg der Waldkonversion zugunsten landwirtschaftlicher Nutzfläche. Trugen in den 70er Jahren mehrheitlich Kleinbauern in spontanen und geplanten Kolonien zur landwirtschaftlichen Erschließung Ostboliviens bei, sind in den folgenden zwanzig Jahren zunehmend großflächige Rodungen für den Anbau annueller Kulturen (insbesondere Soja) in den Kolonien der Mennoniten und in den Gebieten agroindustrieller Großunternehmen zu beobachten. Die rasch nach Osten fortschreitende Expansion landwirtschaftlicher Nutzflächen ebenso wie der Bau von Gaspipelines nach Brasilien, führt durch die Isolierung von Waldarealen zu Veränderungen im Artenspektrum und einer Abnahme der Diversität. Es ist zu erwarten, dass sich dieser Prozess weiter nach Osten fortsetzen wird, weshalb die Region zu der höchst gefährdeten in den Neotropen erklärt wurde (MYERS et al. 2000). Dabei werden zunehmend die biogeographisch und floristisch seltenen Waldübergangsformationen von der Fragmentierung bedroht. Verschiedene Stadien der Walddegradation gehen dabei der Abholzung voraus. Basierend auf der bisherigen Entwicklung der Waldkonversion wird ein GIS-gestütztes Prognosemodell der Waldfragmentierung entwickelt, das in Kooperation mit regionalen NGO's (FAN, FCBC) die geplante Schutzgebietsentwicklung zur Erhaltung geschlossener Waldareale unterstützt.

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BW

Historical developments of landscape patterns and phytodiversity in protected and utilized areas of Burkina Faso and Ivory Coast

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The West African vegetation zones between Guineo-Congolian rain forest in the south and Sahelian savanna towards the north are characterized by a vegetation mosaic of forest islands and different savanna types. In a period of human population increase and climate change in West Africa, the consequences of land-use intensification and habitat fragmentation on biodiversity are being studied with a focus on spatio-temporal dynamics of landscape and phytodiversity (cooperation of the subprojects W01, W04, W11 in the BIOTA network).

For this purpose, two study areas were chosen:

1. The Comoé National Park (CNP) region (NE Ivory Coast) in the transition zone between Guineo-Congolian rain forest and Sudanian woodland. The CNP comprises numerous forest islands of different types and geometries in comparatively homogenous savanna. This vegetation mosaic can be considered as a comparatively primary system that originally characterized many peripheral areas of the humid tropics in the world. In the utilized region directly neighboring the southern park border this landscape mosaic continues, but with traditional agriculture and small plantations penetrating many forests.
2. The drier Sudanian region south of Fada N'Gourma (SE Burkina Faso). Here, increasing land use pressure during the last 30 years has led to severe qualitative changes of savanna phytodiversity. However, savanna enclosures that have been strictly protected for 50 years serve as a reference for quantifying human impact on phytodiversity.

For both regions the development of landscape structure and diversity over the last decades is being directly compared between utilized and protected areas by means of vegetation and remote sensing data. In order to monitor long-term changes of forest islands in the CNP at different spatial scales, a multi-resolution approach was chosen. For large-scale change analysis high-resolution b/w aerial photos and CORONA data were employed to delineate and map the highly fragmented forest patches and their changes down to a size of several meters. Transferring the results of these analyses to coarser resolution and multispectral LANDSAT and SPOT data reveals different types and intensities of forest dynamics in different parts of the study area. It also enables us to transfer the gained knowledge about large-scale landscape dynamics to a much larger area.

In the Fada N'Gourma study area, savanna vegetation patterns, their degree of fragmentation, and their dynamics were investigated by classifying vegetation and land-use units based on LANDSAT satellite images and ground-truth data on vegetation structure, sampled at statistically chosen training areas. Phytodiversity indices were calculated for each vegetation unit by means of phytosociological field data. Furthermore, agricultural fields were classified to calculate land use indices as a parameter of land use intensity. Through temporal analysis of these classifications, land use impact on phytodiversity patterns was evaluated. This approach aims at determining threshold values of land use intensities with respect to the decline of species diversity.

RE

Natural Forest Management in Bergregenwäldern Südecuadors - Eine Option zur Erhaltung von Biodiversität?

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Unter dem Aspekt der Erhaltung der Biodiversität ist die Unterschutzstellung von tropischen Bergregenwäldern in Ecuador sicherlich die beste Option im Umgang mit diesem wertvollen Ökosystem. Es ist jedoch aussichtslos alle Bergregenwälder unter Schutz stellen zu wollen, nachdem die örtliche Bevölkerung nach wie vor auf eine Nutzung drängt. Exploitation des Naturwaldes oder seine vollständige Beseitigung zur Schaffung von Weideflächen sind die derzeit gängigen Nutzungsformen, die einen Rückgang der Biodiversität bewirken.
Im Bergregenwald der Estación Cientifica San Francisco in Südecuador (1800 – 2100 m über NN) sollen basierend auf Inventurdaten alternative Nutzungsstrategien im Sinne eines „Natural Forest Management" gesucht und ihre Auswirkungen auf die Biodiversität abgeschätzt werden. Grundlage der Beurteilung bildet eine Linientaxation in vier Wassereinzugsgebieten von ca. 8, 10, 13 bzw. 16 ha Größe. Insgesamt wurden acht Transekte mit einer Gesamtaufnahmefläche von 4,5 ha angelegt und auf diesen alle Bäume mit BHD > 10 cm erfasst. Die Abundanzen der Individuen mit BHD > 10 cm schwanken zwischen 999 und 1028 und die Bestandesgrundflächen zwischen 26,8 m²/ha und 33,4 m²/ha. In der Gruppe der wertvollsten Arten, zu denen *Prumnopitys harmsiana*, *Podocarpus oleifolius*, *Tabebuia chrysantha* und *Cedrela sp.* gerechnet wurden, fanden sich 27 Potencial Crop Trees (PCT) pro Hektar mit einem BHD größer 10 cm, davon nur 3 PCT mit einem BHD von über 40 cm. Bei den etwas weniger wertvollen Arten, zu denen die Gattungen *Nectandra*, *Clusia* und *Inga* gezählt wurden sieht die Situation ähnlich aus: 144 PCT pro Hektar haben einen BHD von über 10 cm, aber nur 2 davon sind stärker als 40 cm.
Die Abundanzen der nutzbaren starken Wertbäume sind demnach zu niedrig als dass sich eine Holzernte in Form einer Exploitation derzeit lohnen würde . Die vergleichsweise hohe Anzahl an schwächeren PCT legt ein waldbauliches Überführungssystem nahe, das die Erhöhung des Anteils der starken Wertbäume zum Ziel hat. Ausgestaltung und Anwendbarkeit eines möglichen Überführungssystems werden diskutiert.

FT

Differenzierung flugunfähiger Heuschrecken im ostafrikanischen Bergbogen

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Der Ostafrikanische Bergbogen ist ein weltweiter „Hotspot" der Biodiversität. Dies ist auf die hohe Artenzahl, aber in besonderem Maße auf die große Zahl von Endemiten zurückzuführen. Typischerweise haben Insektengattungen ein disjunktes Verbreitungsmuster mit endemischen Arten in den einzelnen Bergblöcken. Eine dieser Gattungen ist die Heuschreckengattung *Afrophlaeoba*. Die Gattung ist enthält vier Arten, wobei *A. usambarica* endemisch für die Ost-Usambaraberge, *A. nguru* für die Nguruberge, *A. euthynota* für die Uluguruberge und *A. longicornis* für die Rubehoberge ist. Alle vier Arten, wie auch die nächsten verwandten Gattungen sind vollständig flugunfähig. Die gesamte *Afrophlaeoba* Gattungsgruppe hat ihren Diversitätsschwerpunkt in den Regenwäldern des östlichen Afrikas. Im Rahmen einer phylogenetischen Analyse wurden vier unterschiedliche Parameter untersucht: Die Differenzierung von Habitatpräferenzen, Balzverhaltens, Morphologie (auch Morphometrie) und mtDNA. Es zeigte sich, dass die Habitatpräferenzen der einzelnen allopatrischen Arten sehr stark ähneln, anders als dies bei sympatrischen Arten in den Usambarabergen der Fall ist. Diskrete morphologische Unterscheidungsmerkmale wurden nicht gefunden. Dagegen waren die Arten durch multivariate Morphometrie gut zu trennen. Auch hier trat jedoch bei zwei Arten eine leichte Überlappung auf. Die genetischen Abstände zwischen den Arten waren recht gering, so dass eine relativ junge Art-Aufspaltung vermutet werden muss. Bei zwei Arten muss sogar der Artstatus als fraglich bezeichnet werden. Die Auswertung des Balzverhaltens zeigte, dass die Unterschiede in Frequenz und Amplitude der Bein- und Antennenbewegungen sehr hoch waren. Es bleibt jedoch unklar, in wie fern diese Unterschiede eine Rolle für das Arterkennungssystem bilden. Die höchsten Unterschiede waren zwischen den genetisch nächst verwandten Arten zu finden, was durch die *Reinforcement* Hypothese erklärt werden könnte, also eine Verstärkung der Differenzierung des Balzverhaltens als Antwort auf sekundäre Sympatrie zweier Arten. Es lässt sich also feststellen, dass Genfluss zwischen den einzelnen Berggebieten zumindest im Pleistozän möglich waren. Hierfür kommen insbesondere die Galleriewälder und Küstenregenwälder in Frage, die die einzelnen Berggebiete miteinander verbinden. Die Trennung der Populationen erfolgte vermutlich zunächst durch ein Austrocknungsereignis im Bereich des Windschattens der Insel Sansibar.

BS

The Potential of Remote Sensing and GIS for Biodiversity Monitoring in southern Africa

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Biodiversity is the essential basis for the functioning of natural ecosystems and of great relevance and potential not only for the livelihood of people but also for aspects of economy. There is a need to develop strategies to deal with the dramatic environmental changes caused by increased population and economic development. Therefore an adequate monitoring and management concept for biodiversity, its spatio-temporal changes and its natural and human induced forcings has to be designed. This is at the focus of the BIOTA project under the BIOLOG program of the German Ministry of Education and research (BMBF).

Remote sensing plays a key role in developing monitoring concepts, as it is an indispensable means by which the land surface can be surveyed at full spatial and temporal coverage, being restricted only by sensor specifications such as spectral characteristics, spatial resolution or repetition times. Together with additional GIS and ground based information of various disciplines, remote sensing data are most valuable to derive parameters relevant for biodiversity research.

Within BIOTA, the remote sensing subprojects S01 and W01 created the basis for a remote sensing and GI (Geographic Information) based system for the analysis and monitoring of vegetation and land surface cover, state and variability. In line with the general research approach of BIOTA, a remote sensing based comparison of sites of different land use intensity and degradation levels caused by socio-economic activity is a major task being performed. In order to be able to serve the interdisciplinary set-up of BIOTA and the transect design with standardized biodiversity observatories, appropriate spatial information had to be made available on a multi-scale basis. Therefore a multi-resolution approach seemed most appropriate. On the observatory level, high resolution aerial photographs were employed and used for small scale analyses: the delineation of vegetation habitat structures on the meso- and micro-scale did not only serve the habitat ranking scheme of the standardized observatory design, but is also used for discipline-specific site analyses, e.g. to delineate faunistic habitats (S07).

On the hierarchical level of the 2000km long transect multi-spectral imagery with resolutions of 20-30 m was chosen for medium-scale analysis of vegetation structure and spatial patterns. Using releve field information of the botanic group (S06), the current state of vegetation is assessed by creating vegetation maps with image classification techniques. These maps form the basis for multi-temporal analysis of vegetation change and dynamics detection, which will be focussed during the remaining time of the pilot and the main phase of BIOTA.

In order to account not only for the human induced changes in vegetation coverage and state, but also for global climate change influence, regional-scale analysis by using moderate resolution imagery (e.g. 500-1000m) is prepared to monitor land surface dynamics. Together with the socio-economic group (S11), focus will be on changes in vegetation state, coverage and patterns, leading to land degradation, in relation to human use, considering further pressure components (e.g. climatic variability). Thus the monitoring scheme consists of analyses of smaller sites at high spatial resolution, nested hierarchically within low spatial but high temporal resolution regional analyses.

Having assessed the land surface characteristics and its change patterns contributes to modelling the habitat development (and S09). Finally, in order to maintain a long-term monitoring and protection scheme within the African countries, capacity building activities for co-operating partner institutions within the fields of Remote Sensing and GIS took place.

FT

Wachstum und Phänologie einiger häufiger Baumarten im südecuadorianischen Bergregenwald

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Im Rahmen der DFG-finanzierten Forschergruppe "Funktionalität in einem tropischen Bergregenwald Südecuadors: Diversität, dynamische Prozesse und Nutzungspotentiale unter ökosystemaren Gesichtspunkten" wird in Ecuador unter anderem das Dickenwachstum einiger Baumarten untersucht. Das Baumwachstum ist ein wichtiger Strukturparameter und läßt zusammen mit den grundlegenden Ergebnissen zur Waldstruktur Rückschlüsse über die Bestandesdynamik zu.

Die Untersuchungen in Ecuador finden seit 1999 im Gebiet der ECSF (Estación Científica San Francisco, 3° 58′ S, 79° 04′ W) statt. Das Untersuchungsgebiet, dessen Vegetation zum größten Teil aus primärem tropischen Bergregenwald besteht, liegt am nördlichen Rand des Podocarpus-Nationalparks in einer Höhe von 1800-3200 m. Die durchschnittliche jährliche Niederschlagssumme liegt bei 2200mm und die Durchschnittstemperatur bei 15° C.

Im Gebiet wurden ca. 550 Bäume mit Durchmessern ab 10 cm mit Dendrometern ausgerüstet. Der Umfangszuwachs wird seit Juni 1999 regelmäßig einmal im Monat an den Dendrometern abgelesen. Gleichzeitig wird die Phänologie von 12 häufigen Arten beobachtet.
Die untersuchten Arten unterscheiden sich deutlich im Dickenwachstum. So weisen Sekundärwaldarten wie *Heliocarpus americanus* (Tiliaceae) und *Piptocoma discolor* (Asteraceae) 39 Monate nach dem Anlegen der Dendrometer durchschnittliche Umfangszuwächse von 55 mm auf, während langsam wachsende Arten wie *Clusia* sp. (Clusiaceae), *Graffenrieda emarginata* (Melastomataceae), *Purdiaea nutans* (Cyrillaceae) und *Viburnum pichinchense* (Caprifoliaceae) im gleichen Zeitraum durchschnittlich 9-18 mm erreicht haben, zur gleichen Gruppe gehört auch *Podocarpus oleifolius* mit ca. 3 mm jährlichem Umfangszuwachs.
Die übrigen untersuchten Arten *Cecropia polyphlebia* (Cecropiaceae), *Clethra revoluta* (Clethraceae), *Isertia laevis* (Rubiaceae), *Tabebuia chrysantha* (Bignoniaceae) und *Vismia tomentosa* (Clusiaceae) liegen im mittleren Bereich mit Umfangszunahmen von 23-43 mm nach 39 Monaten.
Die einzige laubwerfende Art, *Tabebuia chrysantha* zeigt erwartungsgemäß eine ausgeprägte Jahresrhythmik. Aber auch bei einigen immergrünen Arten ist eine leichte Saisonalität beim Wachstum zu beobachten. Generell läßt sich bei den baumförmigen Arten im Gebiet eine Hauptblütezeit während der trockeneren Monate von September bis Dezember feststellen.

Die Zuwachsraten sind standortabhängig sehr unterschiedlich: In den unteren, geschützteren Tallagen des Untersuchungsgebietes erreichen die Bäume ab 10 cm BHD durchschnittliche Umfangszuwächse von 6mm pro Jahr, während in den Kammlagen bis 2250 m die Zuwächse bei 2mm liegen und oberhalb von 2250 m nur noch 1 mm erreicht wird. Ähnliche in Costa Rica durchgeführte Untersuchungen werden interessante Vergleiche ermöglichen.

CC/ED

On the unusual long lasting dominance of a pioneer tree species in an Amazon lowland rain forest

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The forest in the area of the Surumoni Canopy Crane plot (Upper Orinoco, Southern Venezuela) is in parts strongly dominated by the pan-Amazonian tree species *Goupia glabra* Aubl. (Celastraceae), known to be a large pioneer species of late succession stages. So far such a dominance has very rarely been reported. Although this light demanding species offers seeds most of the year and can germinate and establish seedlings very abundantly, it usually becomes displaced in the course of early succession by stronger competitors, e.g. *Cecropia* spp. In order to get some answers for this unusual situation, we studied the stand structure, demography and environmental conditions of the *Goupia glabra* population in the vicinity of the canopy crane plot. Since there are no historical data or observations available, we conclude two possible explanation for the observed phenomenon, (1) *Goupia glabra* has the 'natural' potential to form persisting dense stands, although this has rarely been observed before or (2) a combination of extreme climatic events (ENSO) favoured the establishment of a huge *Goupia glabra* population as well as the unusually long termed competitiveness of this species.

BIOTA Africa – concepts, first results, and perspectives of an interdisciplinary research initiative

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BIOTA AFRICA forms a network of subprojects which cover a wide range of research questions, methodological approaches and geographically defined activities. Besides a "diversity" of approaches, a number of overarching elements define the joint identity of the network. These include:

- A strong concentration on research on the **change** of biodiversity, based on comparative assessment of different stages of degradation of biodiversity due to different stages and intensities of disturbances, land use activities etc. in comparison to relatively natural conditions. At the same time, different processes of change are analysed in detail.
- A strong effort towards long-term **monitoring** the establishment of a continental / global network of biodiversity observatories, using standardised scales and methods.
- A strong **integration** of many disciplines from natural and social sciences, ranging from meteorology, soil science, biogeography, taxonomical foci, ecosystem related foci, use of modelling and remote sensing approaches, animal production, economics, law, ethnology.
- Integration of **social sciences** is strongly aiming at the development of recommendations for biodiversity management, including restoration and conservation aspects as well as sustainable **use of biodiversity**. Consequently, the information policy of intended interventions is of high importance.
- Flexible **spatial approach** including up- and downscaling from micro- to continental scale by use of multiscale biodiversity observatories, which are embedded in mega-transects covering the important biomes of the African continent.
- Strongly developed **international integration process** between German researchers and institutions and colleagues of the host countries, resulting in a joint planning process for the second phase of the program with a string capacity building component.

The presentation will explain the actual structure of BIOTA Africa, show the linkages between activities in various parts of the continent and discuss the perspectives for future activities.

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RE

Unterschiedliche Strategien der Raumbesetzung bei Lianen und Bäumen in verschiedenen tropischen Ökosystemen

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Mehrere Untersuchungen der Arbeitsgruppe haben gezeigt, dass unter vergleichbaren Wuchsbedingungen (insb. Lichtklima) Lianenblätter immer signifikant niedrigere spezifische Blattmasse (g m^{-2}) als die mit ihnen assoziierten Bäume und Sträucher haben. Diese Gesetzmäßigkeit gilt unabhängig von der systematischen Zugehörigkeit der betreffenden Individuen und wurde in allen bisher untersuchten Ökosystemen festgestellt (Afrika: Tieflandregenwald in Gabun und im Nord-Madagaskar; Lateinamerika: Tieflandregenwald sowie laubabwerfender Trockenwald in Costa Rica; Bergregenwald in Ecuador; subtropischer Buschwald, Insel Martin Garcia, Argentinien; Europa: Mediterrane Vegetation). Diese Befunde bedeuten, dass Kletterpflanzen wesentlich weniger Assimilate für den Aufbau ihrer Blattfläche aufwenden und ergänzen wesentlich die bekannte Einsparung der Biomasseinvestitionen in Stützgewebe bei Lianen. Ein weiterer Aspekt sind die meist höheren Blattstickstoffwerte der Lianenblätter. Bei der letzten Expedition „Operation Canopeé" im Herbst 2001 im Masoala National Park, Madagaskar (Pro Natura International, Leitung Prof. Francis Hallé) wurden raumbezogene Proben der Stämme und Zweige aus dem Kronenbereich und dem Unterwuchs entnommen. Die Auswertungen zeigen, dass Lianen pro Einheit des besetzten Wuchsraumes weniger Kohlenstoff investieren als die selbsttragende Vegetation. Aus der Synthese der bisherigen Befunde lässt sich eine kausale Erklärung für die Lianendominanz auf bestimmten Standorten ableiten.

API

The role of Olive Baboons in seed dispersal of a West African Savanna tree (*Parkia biglobosa*, Mimosaceae)

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Being a generalist with a high amount of fruits in its diet and able to move comparatively long distances, the Olive Baboon (*Papio anubis* Lesson 1827) may act as a keystone species for the maintenance of the diversity of woody plants in the savanna of West Africa. I am examining its role as a seed disperser and seed predator in the Comoé National Park (CNP), northern Ivory Coast. The vegetation is a mosaic of savanna and forest islands, with gallery forest along the main rivers.

During 24 months of fieldwork from November 1997 to July 2000, population estimates of primates (baboons and other species) were conducted on a regular basis in an area of approximately 45 km^2 in the Southwest of the National Park. Two groups of Olive Baboons were observed closely, using the scan-sampling method (ALTMANN 1974). Additional observations were made on other primate groups. Fruits and seeds in the diet of the baboons and their treatment were identified by direct observations and by analysis of faeces. Phenology of the most important fruit plants was recorded.

Parkia biglobosa (Mimosaceae) is a large, relatively rare savanna tree of 12-20 m height. Fruiting in CNP usually takes place at the onset of the rainy season, in March and April. Ripe and unripe pods are easily distinguishable by colour. If not harvested, the pods remain dry on the tree for several months. *P. biglobosa* is of economic interest because of multiple uses of different parts of the tree e.g. for human diet, medicine, and dying.
Olive Baboons account for the highest biomass of primates in the investigated area, and are by far the most important consumers of fruits of *P. biglobosa*. Seeds extracted from baboon faeces have proved to germinate. The focus groups regularly visited Parkia trees within their home range, leaving the more or less emptied ripe or unripe pods underneath. The number of potentially dispersed seeds of individual Parkia trees was highly variable between years.
Transect counts of *P. biglobosa* at the end of the fruiting season showed a marked difference in fruits harvested outside the National Park (where Baboons are extremely rare because of illegal hunting) compared to trees inside the Park. Further studies will show, if recruitment is already effected.

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FT

Diversity and Biogeography of Neotropical Epiphytes- how geographical ranges, endemism and species richness of epiphytes in the Andes change with altitude

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Epiphytes may contribute to more than 30% of the species richness and endemics of global biodiversity hotspots, e.g. in the Ecuadorian Andes. Despite of their importance, much of our knowledge on montane epiphyte diversity is based on attempts to understand large scale patterns through a few tiny local inventories (but see Kreft et al., this conference).

We focus on large scale patterns of epiphyte species richness, endemism and range size in the Andes and discuss the underlying mechanisms. This is based upon a detailed analyses of the checklists of Peru and Ecuador, as well as on one of the most comprehensive databases so far on the geographical distributions of Neotropical epiphyte species. Methods involve bioclimatic modelling of species areas and the application of GIS.

Our analyses show a peak in epiphyte species richness between 1000-1500m, and a maximum number of endemic species between 1500-2000m and (slightly lower) 1000-1500m. Differences in species richness between lowland and montane forests are scale dependent.

The altitudinal zone with maximum species richness coincides with the zone of maximum cloud formation. The otherwise rather heterogenous altitudinal patterns of diversity and endemism of epiphytic taxa are dominated by the magnitude of Orchidaceae. Distribution areas of montane epiphyte species tend to be smaller and more fragmented than that of lowland species. These differences are more pronounced for Orchidaceae than for other taxa, especially ferns. Limited range size of montane species does not necessarily correspond to narrow ecological tolerances.

The discussion focuses on two complementary mechanisms which promote large scale species richness in the Andes. First, we concentrate on quality, diversity, and dynamics of habitat which do not explain the origin but promote the coexistence of many species in a given space.

Large scale species richness also corresponds to local and regional species turnover. This is supported by scale dependence of the differences between lowland and montane forests and the specific part that orchids play for the diversity patterns of epiphytes. We argue that speciation processes caused by a highly topodiverse environment are the second driving force for species richness and endemism in the Andes. We hypothesize whether pollination processes are one of the sensitive processes at which isolation comes into effect.

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FT

The pollen box in Cyphiaceae (Campanulales)

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In the flower of the monogeneric family Cyphiaceae – distributed in tropical and southern Africa – a pollen box is formed by the five connivent anthers and the head-like style tip as bottom. Pollen with abundant pollenkitt is released into this box just before anthesis. The flowers either have a salverform shape or they are bilabiate with three petals forming the upper lip; transitions between these flower types can also be observed.

About the flower biology we only can speculate: 1. Flowers, which contain the pollen box, represent the (perhaps long lasting) male phase of anthesis. 2. In the female phase the anthers are spreading and the mouth of the stylar channel opens by disintegration of closing hairs. A mucilaginous secretion coming out of the mouth may receive the pollen from pollinators. 3. Pollinators of the salverform flowers presumably are butterflies, those of the bilabiate ones bees. 4. Pollen is presumably applied at the proboscis of the butterflies coming in contact with the pollen mass between the anthers. If pollinators are bees, pollen may be loaded on the ventral side of the insect (sternotribic pollen loading). The insects may press the pollen box downwards – flower orientation more or less horizontal – so that pollen comes out of the pollen box between the upper two anthers.

Phylogenetically we have chosen – in agreement with sequence data (Gustafsson et al. 1996, Pl. Syst. Evol. 199: 217-242) – the pollen loading into the pollen box, a simple deposition mechanism, as starting point leading to the different mechanisms of secondary pollen presentation in Campanulales (Leins and Erbar in press, in: TF Stuessy, E Hörandl, V Mayer, eds. Deep Morphology: Toward a Renaissance of Morphology in Plant Systematics. Koeltz, Königstein.).

LU

Functional differences between tropical pioneer and late-successional tree species (Sulawesi, Indonesia)

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It has been suggested that the maximal stomatal conductance for water vapour (g_{smax}) is remarkably similar among trees of different forest types and biomes around the globe (about 280 mmol m^{-2} s^{-1}, Körner 1994). We investigated 19 tree species of three different woody vegetation types (natural forest, secondary forest, agroforestry system) in Sulawesi, Indonesia, for sun leaf g_{max} and light-saturated net photosynthesis rates (A_{max}) of mature (pre-mature) trees and related conductance and net photosynthesis to various leaf morphological (size, SLA) and chemical parameters (nutrient contents, $d^{13}C$). g_{max} showed a large variability among the 19 species (68 to 734 mmol m^{-2} s^{-1}) and, on average, was more than twice as high in 8 pioneer trees (609 mmol m^{-2} s^{-1}) as the maximal conductance reported for 8 late-successional trees (368 mmol m^{-2} s^{-1}). Best predictors of g_{smax} were leaf nitrogen per area (N-area) and leaf size. The relationship between g_{max} and N-area was much closer than that to leaf nitrogen per dry mass (N-mass). A highly significant negative relationship existed between g_{max} and leaf size in the pioneer trees which might indicate a reduction in leaf-specific hydraulic conductance of the leaf petiole in very large leaves. Average values of light saturated photosynthesis (A_{max}) among the 8 late successional species (7.5 µmol m^{-2} s^{-1}) were significantly lower than in the 8 pioneer species (17.5 µmol m^{-2} s^{-1}). Both observations evidence the existence of two clearly distinct groups of tropical trees with respect to maximal stomatal conductance and photosynthesis.

API

Ants influence arthropod community structure but not necessarily herbivory on a myrmecophilic savannah tree

Karsten Mody and K. Eduard Linsenmair

A wide range of plants bear extrafloral nectaries (EFNs), which attract ants and other arthropods. Attracting ants through EFNs is often considered an important defensive mechanism of myrmecophilic plants. Although such a protective role is widely attributed to ants attracted by EFNs, their effectiveness as plant defenders is not generally unequivocal. Different studies explained deviations from an expected protection of plants by ants by a) interspecifically variable defensive capabilities of ants, b) habitat dependency of ant foraging behaviour, c) seasonal sensitivity of ant-plant-herbivore interactions, and d) differential susceptibility of herbivores to ant predation. The lack of quantifiable ant protection might also be caused by the reduction of other predatory arthropods (e.g., spiders, parasitic or predatory hymenopterans). The existence of a predictable mosaic of different ant species on neighbouring individuals of the myrmecophilic savannah tree *Pseudocedrela kotschyi* enabled us - by studying the different aspects mentioned above in combination - to assess the relevance of the single factors. Herbivory turned out to be significantly dependent on the species of the respective guarding ant. Short-term ant-exclusion experiments failed to consistently demonstrate the protective effects of ants while longer-term natural experiments (considering neighbouring plants hosting different dominant ant species) revealed significant influence of ant species on herbivory. Additionally, the ants significantly reduced numbers of some arthropod groups which were only in part herbivorous but often predatory (Aranaeida, Blattodea, Coleoptera, Homoptera, non-ant Hymenoptera). Other groups, among them important herbivores, seemed not to be affected (Lepidoptera, Saltatoria, Thysanoptera, Heteroptera). The study suggests that plants may benefit from ant presence if they can attract the 'right' ant species. However, plants gain reduced protection when the 'wrong' ants are attracted which reduce the number of other beneficial arthropods, but are less effective in herbivore deterrence. The findings raise the question whether plants may compete for the best defenders locally available.

BS

Results from socio-economic investigations of BIOTA

Ernst-August Nuppenau

Within the BIOTA framework of monitoring biodiversity in Southern Africa along a transect from northern Namibia to the Cape Peninsula, socio-economic variables, such as living conditions, demography, type of farming, and the human impact on ecosystems, such as impacts of farming on range quality, biodiversity, have been assessed. It is the objective of this contribution to cast more light on the socio-economic conditions and the status of ecosystems at relevant observatories, as being investigated from the point of view of farmers and the society. Our basic hypothesis is, that natural rangeland has degraded due to a non-adaptive-resource use, threatening the livelihood of farmers on communal and freehold land. The presentation will give an overview over current findings of S11 from field research:

- Frequencies and types of domestic animals, game (only commercial), slaughter rates, herd composition, ratios of cows to calves
- Stocking rates on communal and commercial land, determination of flexible stocking rates by bio-economic modelling (commercial farms) and their effect onto the vegetation,
- The structure of land use, grazing types, further range management options used, heterogeneity of vegetation assessment by farmers, knowledge of farmers on plant species, costs of bush encroachment, perceptions of change in range quality
- Property rights and institutional arrangements for using natural pastures (communal: who, when, where, why); property rights and ownership development, especially of degraded rangeland; herding arrangements
- Income from farming, share of farm income in overall income, livelihood diversification, family size and composition, food deliveries, sharing arrangements on meat in communal lands and on commercial farms, income distribution and wages in commercial farms
- Land policy effects on local level, influence of local authorities, examples of positive and negative externalities at local levels, forms of economic co-operation and collective action
- The value of a conservation area as assessed by travel-cost-analysis

Finally, we will discuss tensions of land ownership, property-rights shifts in communal lands, and tendencies to enlarge farms and to embark on a land reform that will change the access to land for different ethnical groups. In particular, land policies and the inclusion of conservation ideas in land use are touched upon.

BE

Habitat fragmentation in southern Arabia: xerotropical ecosystems at their outer limits

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Subject of the interdisciplinary German-Yemeni project reported here, are hitherto largely unexplored relics of tropical palaeo-African ecosystems in the southern coastal mountains of the Arabian Peninsula and on Socotra. These tropical ecosystems have survived the post-Tertiary aridisation of the entire region in isolated refugia within a harsh desert environment, thanks to favourable coincidences of local climatic, topographic and edaphic factors.

The refugia are bioclimatically and ecologically conspicuously differentiated and their plant cover comprises shrub formations as well as deciduous and semi-deciduous woodlands of various composition. Examples of such refugia and their prerequisites are shown, the structure of sheltered ecosystems is illustrated, and ample evidence for the importance of the gene pools preserved in these refugia demonstrated with reference to vascular plants and bryophytes.

Evidences for a reconstruction of the former tropical woodland vegetation in South Arabia and their relationships with the Horn of Africa region inferred from floristic, phytogeographical and vegetational analyses of these relics are briefly introduced.

First results of phylogeographical studies aiming at a reconstruction of the sequence of isolation processes leading to the refugia under study are presented. The distribution patterns of chloroplast haplotypes (from cpDNA PCR-RFLP analyses) in populations of the *Maytenus senegalensis / M. dhofarensis (Celastraceae)* group, of *Justicia areysiana (Acanthaceae),* and of *Cadia purpurea (Fabaceae)* are compared and discussed in conjunction with floristic and phytogeographical results.

Similar to the situation regarding the flora, the fauna of Southern Arabia consists of a unique and complex mix of widespread afrotropical species, highly specialised endemics and remnant populations of palaearctic species. Results of phylogeographical and population genetic studies in *Reissita symonyi* contribute also to the understanding of the role of fragmentation processes in the history of South Arabian biodiversity. Additionally, comparisons with results in the *Maytenus senegalensis / M. dhofarensis* group, the larval host plants of *Reissita symonyi,* permit insights into the genetic structure of coevolutive systems.

Finally the question of habitat fragmentation and its effects on the genetic diversity of fragmented populations is addressed and exemplified with the S Arabian moonsunal *Anogeissus* woodland, which is naturally fragmented on various scales.

FT

Impact of selective logging of four tree species on natural tree regeneration in different woodlands (Benin, West Africa)

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Within the IMPETUS -project (Integrated Approach for Efficient and Sustainable Use of Fresh Water in West Africa, supported by the BMBF) the subproject "Biosphere" deals with functional relationships between spatio-temporal vegetation dynamics and water cycle. All studies are carried out in the upper valley of the Ouémé, in the central – western part of Benin. This area is up to now fairly populated and characterised by relatively naturale plant formations, which are influenced by two factors: (1) Highly destructive is the migration of people, mainly from the north, into the investigation area leading to the conversion of natural vegetation into settlements and fields. (2) Selective logging is the most important factor driving spatial dynamics of the vegetation in the study area. Logged tree species are *Afzelia africana, Khaya senegalensis, Isoberlinia doka* and *Pterocarpus erinaceus*. Logging activities started around 1950 with two tree species (*A. africana and K. senegalensis*) and continue until now.

The aim of this study is to characterise the impact of selective logging on the natural regeneration in dominant woodland and savanna types of the Sudanian region. Permanent plots were installed in six different vegetation types both in disturbed and undisturbed areas. On these plots all life stages of tree individuals were monitored and environmental factors such as air temperature and – humidity, radiation, and soil parameters were measured. Seedlings and saplings of tree individuals were monitored in 2001 and 2002 at the end of the dry season and end of the rainy season.

First results revealed that environmental factors were not decisive for the regeneration potential of the four logged tree species. Most important for natural tree regeneration on a beal scale is the presence of fertile tree individuals. For a sufficient production of diaspores trees must attain a minimum DBH of 45cm.

RE

Vogelgemeinschaften in südecuadorianischen Bergregenwäldern unterschiedlicher Struktur

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Im Rahmen der DFG-Forschergruppe „Funktionalität in einem tropischen Bergregenwald Südecuadors: Diversität, dynamische Prozesse und Nutzungspotentiale unter ökosystemaren Gesichtspunkten" werden am Lehrstuhl Biogeographie der Universität Bayreuth funktionale Verknüpfungen zwischen Vegetationsstrukturen und Vogelgemeinschaften untersucht. Die Grundlage hierzu stellt eine auf strukturellen Merkmalen beruhende Klassifikation ungestörter und gestörter Waldeinheiten dar.

Als Methode zur Erfassung der Vogelwelt wurde eine Kombination aus Punkt-Stop-Erfassung, Netzfängen und Zufallsbeobachtungen angewendet. Hierbei konnten die Beobachtungs- und Fangstellen gezielt in die unterschiedlichen Habitattypen gelegt werden, was für einen Vergleich der Artenzusammensetzung verschiedener Struktureinheiten von besonderem Vorteil ist. Die Markierung gefangener Vögel mit Farbringen ermöglichte zusätzliche Aussagen über deren Aufenthaltspräferenzen bzw. Migrationen im Untersuchungsgebiet.

Insgesamt konnten 213 Vogelarten beobachtet, gehört oder gefangen werden. Dabei stellen die Tyrannen (*Tyrannidae*) mit 36, die Tangaren (*Thraupidae*) mit 34 und die Kolibris (*Trochilidae*) mit 27 Arten die artenreichsten der 38 nachgewiesenen Familien dar. Acht der vorkommenden Arten sind in der „Roten Liste" der Vögel Ecuadors aufgeführt, wobei zwei dieser Arten in Südecuador (bzw. Nordperu) endemisch sind.

Bei einem Vergleich von fünf verschiedenen Waldstrukturtypen zeigt sich, dass der Typ „Waldrand mittlerer Höhenlagen" am artenreichsten ist und der Artenreichtum zu den Strukturtypen des primären Bergregenwaldes hin abnimmt. Betrachtet man die Habitatpräferenzen dieser Vogelarten, so werden in allen Waldstrukturtypen ca. 65% von Arten gebildet, die sowohl im geschlossenen Wald als auch am Waldrand vorkommen. Die typischen Waldarten nehmen von den Strukturtypen des primären Waldes zu den Waldresten hin ab, während die typischen Waldrandarten in der gleichen Abfolge zunehmen.

Für alle untersuchten Waldstrukturtypen lassen sich Arten finden, die ausschließlich in diesen Einheiten vorkommen. Als Beispiel für die funktionalen Zusammenhänge zwischen der Vegetationsstruktur und dem Vorkommen von Vogelarten lässt sich das Beispiel des Andenschopfohrs (*Pseudocolaptes boissonneautii*) aufführen. Diese Art findet sich ausschließlich im Strukturtyp „Meso-, makro-, megaphyller Gratregenwald". Der hohe Totholzanteil und der Reichtum an epiphytischen Bromelien in den Baumkronen dieses Strukturtyps entsprechen genau den Anforderungen dieser Art für Brut und Ernährung.

Derartige Zusammenhänge werden zur Zeit auch für die anderen Vogelarten untersucht.

RE

Development of species diversity in the restoration process of establishing a tropical man-made forest ecosystem in China

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Restoration of tropical Seasonal evergreen forest depends on improving soil fertility and Species diversity. Research has shown that Soil fertility can be improved gradually after vegetation recovery. In this paper, the development of species diversity and its effect on the restoration process in tropical China have been studied based on the survey of a long-term site. The main results are as follows.

(1) After vegetation recovers in a degraded ecosystem, species diversity expands quickly. Species structure moves toward that of the climax structure in spite of different initial species combination and habitat. Of 72 tree species existing in a 1400 m^2 site of man-made mixed forest, 47 tree species are natural colonizing species which are all common species native to this region of China. These results show that species diversity can be restored in a degraded tropical seasonal evergreen forest ecosystem.

(2) The restored forest develops toward the zonal vegetation type. The speed at which it develops seems uneven. By measuring the β-diversity index of restored forests established at different times, it can be shown that the community habitat differences between subsequent years become increasingly larger. Although this pattern is affected by many tangled factors, forest age is probably the most important. This might suggest that the restoration of species diversity occurs faster in the early and middle stages of the process or vegetation development.

(3) The soil fertility, plant species diversity and the diversity of mammals, birds and microbes appear to mutually facilitate one another.

Keywords: Tropical seasonal rain forest; Species diversity; Restoration; Degraded ecosystem.

API

Decrease of a keystonspecies and predator community shift in East African rainforest fragments

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Fragmentation of tropical rainforests is a major threat to earth's biodiversity. Most studies conducted so far concentrated on species loss within very small forest fragments. However, processes in larger fragments (many nature reserves, national parks) - on which the maintenance of biodiversity may depend – may be more subtle but are less understood. From June to August 2002 we conducted research on a keystone predator of East African tropical ecosystems – the army ant *Dorylus molestus*. *D. molestus* is an epigaeic forager performing swarm raids in the leaf-litter and lower vegetation (thereby involving up to 10.000.000 workers). The swarm raiding behaviour of *D. molestus* is supposed to effect ecosystems like an intermediate disturbance by which high levels of biodiversity are maintained. Our study area included 5 mainforest plots and 4 large sized fragments (100 to 1500 ha) of Kakamega Forest, Kenya. Quantifying the number of army ant trails on 1700 m transects once a week, we tested if the colony density of *D. molestus* and other hypogaeically foraging army ant species was affected by fragmentation processes.
We found *D. molestus* in all surveyed plots of Kakamega Forest. However, first data point to changes on the population level: Forest fragmentation had negative effects on the colony density of *D. molestus*. Moreover, the colony density of the epigaeic forager *D. molestus* is negatively correlated with colony densities of more hypogaeically foraging army ant species. This indicates a shift within the top trophic level of the ecosystem, and may have major effects on the biodiversity of tropical rainforest fragments.

The study was supported by the DAAD and conducted in close cooperation with BIOTA East Africa.

LU

Conservation Lama Forest - Role of Forest Plantations for the Viability of Natural Forests

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The Lama forest in Benin is one of the last remnants of the forest/savannah mosaic – known as the Dahomey gap – between the West African and West-central African lowland rainforests. It is composed of natural forest (2,500 ha), degraded forest/savannah (4,759 ha) and forest plantations of exotic species such as teak and Australian acacias (9,000 ha). Lama forest has the protection status of a "classified forest". It is home to several endangered wildlife species and rare plants and is, therefore, of primary concern in national biodiversity conservation programmes. However, species inventories conducted so far largely ignored invertebrates and other biota. Moreover, the focus was on the natural forest, whereas the surrounding forest plantations and the degraded forest/savannah landscape have received little attention as yet, despite their larger size. The present study (project acronym: BIOLAMA) is based on the assumption that conservation and forest management strategies must be founded on an understanding of spatial, structural and functional relationships between these different forest landscape elements. The study aims to elucidate the role of anthropogenic forests as buffer zones, migration corridors and surrogate habitats for the flora and fauna of Lama. Selected biota are inventoried and monitored in all major habitats, with emphasis on biota which have not been considered in previous studies, in particular understorey plants as well as detritivorous (litter-feeding) and xylophagous (wood-feeding) invertebrates. Functional aspects such as decomposition of organic matter and nutrient-cycling in relation to forest type and forest management are also being investigated. Our research is executed in close co-operation with the *Office National du Bois* (ONAB) and the *International Institute of Tropical Agriculture*. The approach pursued is considered a case-study for the management and conservation of isolated biodiversity resources in Benin and other African countries.

FT

The effects of market hunting on monkey populations in the Taï National Park, Côte d'Ivoire

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The impact of hunting on primate species was studied in the Taï National Park and adjacent forests in Ivory Coast . The average bushmeat consumption per capita/per year was assessed from market surveys and interviews. We determined that the amount of primate bushmeat being extracted in the Tai National Park and surrounding forests was 902.9 t in 1999. Hunting pressure was highest on the larger primate species such as red colobus (*Procolobus badius*), black & white colobus (*Colobus polykomos*) and the sooty mangabey (*Cercocebus torquatus atys*). Estimates of population densities were based on line transect surveys. The maximum annual production of each species was calculated using the Robinson and Redford model (1991). Comparing current harvest levels with the maximum sustainable yield suggests that current off-take exceeds sustainability by three to eleven times. As many areas are already depleted, hunters journey further into the centre of the national park. The promotion of programs to ensure the production of domestic animals and reared fish could help to substitute the consumption of wild meat.

RE

Aspects of Ecological Functionality in Agroforestry Systems Counteracting Pedoclimatic Constraints in the Central Amazon

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Most soils of the terra firme rain forest of the Central Amazon are strongly weathered clayey ferralsols which are characterized by high contents of iron and aluminum oxides, low nutrient availability and a strong tendency to degrade within few years. Numerous scientific work is concerned with the question, how to counteract the progressive loss of soil fertility in agricultural systems in this region. The general challenge is to sustain system stability without high inputs of agro chemicals because these are not available for the majority of the land owners of the Amazon region due to logistic and/or economic limitations. Idealized low input systems provide a maximum efficiency of resource utilization and a minimum of resource loss, thus, reducing the needs for compensating inputs. This can be approached when the design of an agro-ecosystem allows for internal cycling and temporal and/or spatial complementarity of resource use. When features of ecological functionality are realized in a low input system, this will be reflected in the stability and consequently in the productivity of the respective agro-ecosystem.

Within the bilateral SHIFT-program a comparative study of different agroforestry systems on a clayey ferralsol has been initiated in 1993 near Manaus, Amazonia. It became evident that the productivity of crop plants (especially of *Theobroma grandiflorum*) was strongly influenced by system variables such as species composition and spacing, whereas the effect of different fertilization levels was negligible. Thus, the system mediated differences in plant performance are due to different degrees of ecological functionality. Some approaches to explain mechanisms leading to these system mediated differences will be presented combining findings of different studies conducted at the experimental site.

API

Bedeutung der Landnutzungsdynamik und Waldentwicklung für die avifaunistische Diversität eines tropischen Bergnebelwaldes in Guatemala

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In den Bergnebelwäldern Guatemalas werden parallel Untersuchungen zur Avifauna und zur Landschaftsökologie durchgeführt[1]. Von diesen gemeinsamen Untersuchungen umfasst der landschaftsökologische Teilaspekt die Bewertung des Landnutzungspotentials und der Landschaftsstruktur unter Berücksichtigung der Erhaltung der Biodiversität. Auf der Basis von Satellitenbild- und Luftbildauswertungen werden die Entwicklung der Landnutzung sowie Waldkonversions- und Fragmentierungsprozesse aufgezeigt, um Schlussfolgerungen im Hinblick auf die Notwendigkeit der Unterschutzstellung von Gebieten zu ziehen. Aus naturschutzbiologischer Sicht wird die Struktur der Vogelgesellschaft in unterschiedlichen Habitaten untersucht. Am stärksten verbreitet in der Untersuchungsregion sind die Habitate Primärwald, Sekundärwald und das *milpa*-system. Das *milpa*-System bezeichnet den traditionellen Anbau im Mai-/Bohnen-Agrosystem der Q'eqchi-Bevölkerung.
Das Untersuchungsgebiet liegt im Bergnebelwaldbereich der Sierra Yalijux in Alta Verapaz, Guatemala (15°28'N, 90°20'W). Die verbliebenen Waldfragmente befinden sich auf einer Höhe zwischen 1900 und 2531m. Hauptfaktoren für die Waldkonversion sind die kleinräumige slash-and-burn-Landwirtschaft (0,5 bis 3 ha) sowie der Holzeinschlag. In Guatemala hat sich der Waldbestand von 77 % im Jahre 1960 auf heute 26,6 % verringert. Zur Zeit liegt die Abholzungsrate in Guatemala laut FAO bei 1,7 %. Die Hauptverluste finden im Tiefland statt, der Druck auf die Waldressourcen verlagert sich aber zunehmend auf die Bergnebelwälder. Die Bergnebelwälder sind von einzigartiger Besonderheit, zudem stellen sie nur einen geringen Prozentsatz an der Waldverteilung in Guatemala dar. Eine zunehmende Habitatfragmentierung ist auch im Untersuchungsgebiet vor allem durch semi-spontane Bergnebelwaldkolonisation zu verzeichnen.
Ein deutlicher Gradient hinsichtlich des Mikroklimas in den unterschiedlichen Habitaten ist bezüglich der Lufttemperatur, der Bodentemperatur sowie relative Luftfeuchtigkeit nachweisbar: Primärwald > Sekundärwald > *milpa*-System. Der Landnutzungswandel verändert die Vogeldiversität in Bezug auf Artenzusammensetzung, Populationsdichte und Gildenstruktur. Die Veränderungen der Habitate von Primärwald zur Sekundärvegetation beeinflusst weniger die Gilde der nectarivoren als die Gilde der insectivoren.
Insgesamt sind im Bergnebelwald sieben endemische Vogelarten durch die Landschaftsveränderungen gefährdet. Es gibt mindestens vier weitere Arten (u.a. *Penelopina nigra, Cyanolyca pumilo*), die in der Sierra Yalijux negativ durch die Landnutzungsdynamik beeinflusst werden. Der Primärwald dient als Refugium für wichtige Arten wie zum Beispiel Quetzal (*Pharomachrus mocinno*) oder Schwarzkopfhäher (*Cyanocitta stelleri*) und stellt im Sinne des Übereinkommens zur Erhaltung der biologischen Vielfalt eines der letzten Gebiete dieser Art in Guatemala dar.

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BW

Pristine versus altered: how do frogs cope?

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The Upper Guinea forests are among the 25 most important biodiversity hotspots of the world. However, these forests are highly threatened by logging, agriculture and an increasing human population (e.g. about 80% of the forests in western Ivory Coast have been destroyed during the last 20 years). Remaining forests are mainly degraded and often highly fragmented. It is completely unknown how degradation and fragmentation might affect the regional biodiversity that consists to a large extent of endemic species. One group of organisms, highly endemic in the region and generally known to be sensitive to environmental constraints, could act as a model system to predict the consequences of the destruction of pristine habitats: amphibians.

We therefore started investigating amphibian assemblages in different pristine, degraded and fragmented forests in western Côte d'Ivoire. The Taï National Park (TNP), the largest remaining area of lowland rain forest in West Africa, was chosen to represent the pristine condition. Its edges, selectively logged about 20 years ago, served as an example for degraded forests. In addition, we investigated the amphibian communities of two "classified forests" with recent logging activity, and those of 14 forest fragments, differing in size, degree of degradation and time since isolation from the TNP forest bloc.

Amphibian communities of pristine, degraded and fragmented forests differed considerably in diversity, community composition and predictability. Primary forest sites showed highest diversity. Their distinct species assemblages existed, but could be predicted only by geographic proximity, speaking in favor of differing local species pools. Assemblages in secondary forest were predictably based on environmental parameters. This was due to physiologically more restrictive conditions, allowing only highly adapted or tolerant species to survive.

FT

Studies on the phenology of African myco-heterotrophic plants

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Myco-hetrotrophic plants receive all essential nutrients (including carbohydrates) from endomycorrhizal fungi, which are colonizing their roots and/or rhizomes. The lack of leaves and chlorophyll as well as their subterraneous habit lead to the assumption that they live as parasites on their associated fungi.

Since the life cycles of tropical myco-heterotrophic plants (except Orchidaceae) are completely unknown, a BIOLOG – financed phenological study was undertaken at southern Korup National Park, Cameroon. Eight out of twelve myco-heterotrophic plants known to occur in the park, were studied along a ten kilometre transect. Aim of the study was to document the process of anthesis, fruit formation and the size of each population per season. Besides this, it was aimed to find out whether the plants are seasonal or perennial.

Field observations were carried out within two week intervals. For two species, *Sciaphila ledermannii* Engl. (Triuridaceae) and *Afrothismia winkleri* (Engl.) Schltr. (Burmanniaceae, Thismiae), ten individuals each, were tagged and observed twice a month.

The study revealed that in seven out of eight species, flowering and fruiting occurred exclusively during the rainy season (April – November). *Sciaphila ledermannii*, being the only exception, was found flowering and fruiting throughout the year in one locality. Since myco-heterotrophic plants completely depend on their associated fungi, these observations provide useful information on seasonal changes in the vitality of their fungal hosts.

FHI

Effects of forest fragmentation on the physiology and population characteristics of grey mouse lemurs in littoral forests of southeastern Madagascar

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Seasonal fluctuations in resource availability and climate can influence an animal's anatomy and behavior in a variety of ways, depending on the specific physiological response of the particular species. The grey mouse lemur, (*Microcebus murinus*), utilize two major strategies to overcome the potential energy imbalance during the unfavorable time of the year: hibernation or staying active but entering into daily torpor. Field studies in deciduous dry forests in Madagascar revealed that grey mouse lemur females differ from males with respect to their thermal physiology and patterns of torpor. Furthermore, the work illustrated how important a suitable habitat is to maintain viable and healthy populations of this species.
The main goal of the present study is to investigate whether the fragmentation of the littoral forest of southeastern Madagascar has an effect on the thermal physiology and population characteristics of *M. murinus*. For this, permanent plots for trapping were installed in four forest fragments (M16, M13, M20 and M5) that differ in size and degree of degradation. Captured animals were sexed, weighed and individually marked (transponders), and standard morphometric measurements were taken. Trapping was conducted in July and October of the year 2001, and monthly between March and November in 2002.
The findings of the present study are diverse and so far, there are no clear indications that thermoregulatory capacities and population characteristics of *M. murinus* were affected by fragmentation. The study received financial support from the Deutsche Forschungsgemeinschaft (DFG; SCHM 1391/2).

RE

Bergwaldregeneration am Mt. Kilimanjaro, Tanzania: Synthese von Biodiversitätsdynamik und Nährstoffdynamik

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Tropische Bergregenwälder erfüllen als Wasserspeicher und Lebensraum vieler endemischer Arten wichtige Funktionen. Störungen wie Holznutzung oder Feuer führen zunächst zu einer Veränderung von Flora und Fauna sowie des Wasser- und Nährstoffhaushalts. Im Laufe der Regeneration beeinflussen sich abiotische und biotische Faktoren wechselseitig. So fördern die nach Störungen veränderten Lichtverhältnisse und ein meist gesteigertes Nährstoffangebot das schnelle Aufwachsen von Arten, die von diesen Bedingungen profitieren. Auf der anderen Seite beeinflusst die aufkommende Vegetation die Entwicklung der Wasser- und Nährstoffflüsse etwa über den Wurzelentzug von Wasser und Nährstoffen, die Menge und Qualität der anfallenden Streu, den Deckungsgrad und die damit verbundene Interzeption und die Wasserspeicherung durch epiphytische Farne und Moose. Im Idealfall beeinflussen sich Artenzusammensetzung und abiotische Prozesse im Laufe der Regeneration so, dass sich letztlich in späteren Stadien wieder die ursprünglichen Verhältnisse einstellen. Um diese Wechselbeziehungen verstehen zu können, ist es in einem ersten Schritt wichtig herauszufinden, ob und welche abiotischen Faktoren mit der Artenzusammensetzung im Laufe der Regeneration korrelieren.

In einem Gemeinschaftsprojekt des Lehrstuhls Biogeographie und des Lehrstuhls Bodenkunde und Bodengeographie der Universität Bayreuth wurden verschiedene Aspekte der Bergwaldregeneration am Mt. Kilimanjaro untersucht. Dazu zählten die strukturelle und floristische Diversität der Vegetation, die Bodeneigenschaften und Parameter des Wasser- und Nährstoffkreislaufs. Von beiden Arbeitsgruppen wurden sechs junge, noch baumfreie Regenerationsstadien, fünf Sekundärwälder sowie vier Naturwaldstandorte untersucht. Um die Ergebnisse vergleichbar zu machen, wurde von beiden Arbeitsgruppen auf exakt den gleichen Flächen gearbeitet. Mit Hilfe von Manteltests wurden Distanzmatrizen der Vegetationsaufnahmen (Sørensen-Index) mit denen verschiedener Umweltparameter (quadrierte Euklidische Distanz) verglichen.

Zwischen verschiedenen Bodenparametern wie pH-Wert, Kationenaustauschkapazität oder Vorräten an C, N und S im Boden und der floristischen Zusammensetzung konnte kein Zusammenhang festgestellt werden. Ein signifikanter Zusammenhang zeigte sich dagegen zwischen der Artenzusammensetzung und der Höhe des Bestandesniederschlags, der Nährstoffeinträge über den Bestandesniederschlag (insbesondere für K und NO_3, nicht aber für Ca und NH_4), der Nährstoffkonzentration im Streuperkolat sowie der Bodenlösung in 15cm Tiefe (insbesondere für K, Mg, Ca und DON, nicht aber für Na und NH_4). Die Untersuchung der Stoffflüsse ergab, dass sich die jahreszeitliche Variabilität der Nährstoffkonzentrationen einiger Stoffflüsse auf den untersuchten Regenerationsstadien unterschied. Die Varianzen der Stoffkonzentrationen im Jahresverlauf im Bestandesniederschlag und im Streuperkolat zeigten einen signifikanten Zusammenhang mit der Vegetationszusammensetzung. Insgesamt konnte eine Reihe von abiotischen Parametern identifiziert werden, die sich im Laufe der Regeneration mit der Vegetation verändern. Insbesondere in frühen Regenerationsstadien muss aber damit gerechnet werden, dass die Stoffflüsse noch mehr vom Störungsereignis selbst als von der Vegetation beeinflusst werden.

LU

Biodiversity indicator taxa of tropical land-use systems: comparing plants, birds and insects

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Changes in biodiversity in response to human impact are known to differ widely among taxonomic groups. In a multidisciplinary collaboration we used inventories of trees, understorey plants, birds, butterflies, and dung beetles in Sulawesi (Indonesia), to characterise a gradient from near-primary to secondary forests, agroforestry systems and annual crops (n= 12-20 sampled sites). Overall species richness tended to decrease within this gradient of increasing habitat modification, but in contrast to previous studies, we found the species richness between most taxa to be significantly correlated (36 out of 38 pairwise comparisons). However, on average only 48% of the variance could be explained (within the five main groups), and only few taxa/guilds turned out to be good predictors for others. Although biodiversity of land-use systems showed taxon and guild specific differences, most groups were affected in a similar way by habitat modification. Near-primary forest sites proved to be of principal importance for conservation. However, certain land-use systems supported relatively high numbers of species and might – to a yet unknown extent – play a significant role for biodiversity conservation in tropical landscapes.

FT

Biodiversity of the Kakamega Forest in Kenya and the impact of increasing pressure through population: a new technique for assessing area averaged change in trace gas exchange between ecosystems and the atmosphere.

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In Kenya population is putting severe pressure on the remaining rainforests resulting in a loss of biodiversity. Up to now most of the forests have been transformed to agricultural land or intensively used forests. One of such an agro-forest is the Kakamega Forest. In this forest, a gradient of disturbance could be observed ranging from patches of primary rainforest over secondary rainforest, plantations to pure agricultural areas. This loss in biodiversity is supposed to change the trace gas exchange between the ecosystems and the atmosphere. Despite the importance of trace gases such as N_2O, CH_4, and volatile organic compounds (VOC) for the climate and air quality, our knowledge of exchange rates between disturbed rainforests and the atmosphere is very limited. The main reason for that may largely be due to the fact that measurements in these areas are difficult to conduct.

We have developed a methodology to measure the trace gas exchange of forest ecosystems facing different grades of disturbance by an aircraft based instrumentation within the frame of the BIOTA-East project. By using aircrafts also hardly accessible landscapes can be investigated. On the basis of air mixing ratio measurements of compounds of interests in combination with wind speed and wind direction measurements, area averaged fluxes can be derived. In a first approach we used inversed modelling to derive surface fluxes. In this approach the surface flux can generally be described by multiplying the mixing ratio difference between the downwind and the upwind site multiplied with the wind speed. All necessary devices for collecting air samples and measurements systems for geographical location of the aircraft, actual wind speed and direction have been assembled in two pots which easily can be attached to the wings of small aircrafts. For sampling the desired model input parameters, specific flight tracks have to be designed depending on local land use pattern and the current meteorological situation. The flight height is approximately 100 m above ground allowing the investigation of small areas of a specific land-use type down to approximately 1-5 km^2 depending on wind speed. First results of a flight campaign over the Kakamega Forest will be presented. This system will further be developed allowing flux measurements based on the relaxed eddy approach.

BW

Climate variability and land cover dynamics in Côte d'Ivoire as crucial aspects for terrestrial biodiversity

Methods and first results of an integrative monitoring approach

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During the past five decades essential anthropogenically induced land cover changes took place in Côte d''Ivoire, West Africa. At the same time, the country suffered from a rainfall deficit at least for the last three decades. Results of this paper support the idea that regional variability in precipitation with regard to its temporal and spatial distribution is considerably linked to significant changes in vegetation cover. The environmental impact on the ivorian socioeconomy and natural biodiversity, however, remains elusive. In frame of the BIOTA-West scientific research network a multi-scale monitoring concept was designed, combining most suitable and advantageous features of remote sensing and bioclimatic ground observations in order to examine the following focal points: a) monitoring of large scale vegetation dynamics; b) change detection of vegetation and land surface characteristics (particularly human induced changes of different degradation intensity); and c) the importance of changes within biosphere – atmosphere interactions.

API

Diversity of anthophilous insects of two native plant species (*Syzygium guineense* var. *macrocarpum* and *Ximenia americana* (Olacaceae) in the high altitude savannah of Ngaoundéré (Cameroon)

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In the savannah of Ngaoundéré (Cameroun), from December 2000 to March 2001 and from December 2001 to March 2002, flowers of *Syzygium guineense var. macrocarpum* (Engl.) F. White (Myrtaceae) and that of *Ximenia americana* L. (Olacaceae) have been prospected in view to census insects visitor and to determine the needs that bring them on each plant species. The main objective of this research was to contribute to the knowledge of Insects - *S. g. macrocarpum* and *X. americana* relationships, for an efficient management of these plant species. 63 and 44 insect species visited the flowers of *S. g. macrocarpum* and *X. Americana* respectively, for many needs. 62 and 43 of these species are noted for the first time on *S. g. macrocarpum* and *X. americana* respectively. Insects observed on *S. g. macrocarpum* belong to six Orders: Hymenoptera (87.3% of all species), Diptera (27.3%), Lepidoptera (9.1%), Coleoptera (15.9%), Hemiptera (4.8%) and Orthoptera (4.8%). Those observed on *X. americana* belong to five Orders: Hymenoptera (56.8%), Diptera (27.3%), Lepidoptera (9.1%), Orthoptera (4.5%) and Coleoptera (2.3%). 17.5% and 22.7% of all insects visitor of *S. g. macrocarpum* and *X. americana* respectively had more than one activity on flowers. Among the 63 insects species observed on *S. g. macrocarpum*, 87.3% harvested nectar, 11.1% collected pollen, 9.5% ate plant tissues, 4.8% sucked sap, 3.2% searched their sexual partners, 1.5% hunted their preys. Among the 44 insects species observed on *X. americana,* 86.4% harvested nectar, 20.5% collected pollen, 6.8% ate plant tissues, 2.3% hunted their preys. The frequency of visits varies with years and plant species. An efficient control of harmful insects (tissue consumers and/or sap suckers) should save harmless anthophilous insects (nectar and /or pollen collectors) who can increase fruit and grain yields via their intervention on the pollination.

Key words: *Syzygium guineense var. macrocarpum, Ximenia Americana*, flowers, insects, needs, Cameroon.

API

Field observations on the pollinators and seed dispersers of *Marcgravia longifolia* in Amazonian Peru

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We observed nectarivorous and frugivorous visitors of the liana *Marcgravia longifolia* (Marcgraviaceae) at the Estación Biológica Quebrada Blanco (EBQB) in north-eastern Peru (4°21'S 73°09'W). *M. longifolia* differs from many other members of the genus by its downward facing flowers and the almost sessile nectaries. During the nocturnal anthesis, we observed a phyllostomid bat, probably *Anoura caudifer*, visiting flowers of *M. longifolia*. Pollination by bats and by non-flying mammals has been reported from other *Marcgravia* species. The presence of ripe fruit of *M. longifolia* is clustered between October and December. Three primate species – *Saguinus fuscicollis*, *Saguinus mystax*, and *Callicebus cupreus* – were observed feeding on these fruit. For the two *Saguinus* species, *M. longifolia* is amongst the five most important plant food species during months of maximum consumption (October-November). Seeds were recovered from faeces of all three primate species. Dispersal distances averaged 199 m ± 113 m (n=12 dispersal events) and 197 m ± 93 m (n=13 dispersal events) for seeds dispersed by *S. mystax* and *S. fuscicollis*, respectively. Seeds remained viable, but viability was reduced in comparison to control seeds taken from ripe fruit. This is the first documentation of primate seed dispersal of a species from the family Marcgraviaceae. Other frugivorous visitors that are potential seed dispersers include the manakins *Pipra pipra* and *Pipra cornuta* (Pipridae).

API

Hovering thieves and perching pollinators: Bat pollination of the understory palm *Calyptrogyne ghiesbreghtiana*

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Inflorescences of the Central American understory palm *Calyptrogyne ghiesbreghtiana* offer bats fruit-like flower tissue as reward for visitation. I monitored inflorescences using infrared video and could document that visitors to the inflorescences differed fundamentally in their exploitation behavior, with significant consequences for pollination success. Bats visited the inflorescences in two different modes: frugivores (Phyllostomidae: Stenodermatinae, Carolliinae) foraged on the inflorescence while perched, in contrast to mainly nectarivore bats (Phyllostomidae: Glossophaginae) that also consumed the flower tissue, but did so in hovering flight. These different visitation modes had consequences for pollination success of the palm: Fruit set was significantly lower in inflorescences that had received only hovering visits, indicating that perching behaviour offered better possibilities for pollen transfer.

While the pollination system of *C. ghiesbreghtiana* is probably adapted to perching, predominantly frugivore bat visitors, hovering Glossophagines also exploit the inflorescences, yet they are less efficient pollinators. Seen from the plant's view the nectar-specialist Glossophagines are non-optimal participants that profit from an otherwise evolved pollination system. Glossophagine bats have flexible flower-visiting behaviour, driven by very high energy demands. They may readily enter existing floral interactions but do not always contribute effectively to pollination. In an evolutionary perspective the *Calyptrogyne ghiesbreghtiana* - glossophagine bat interaction may under certain conditions demonstrate a way of recruitment of new efficient pollinators from non-destructive flower visitors.

FHI

Increase of leaf-cutting ant density through forest fragmentation: a result of altered trophic structure?

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Leaf-cutting ants (LCA) are dominant harvesters of foliage in lowland tropical rainforests. During the last decades it has been realized that the abundance of LCA has dramatically increased. This has been attributed to the increasing rate of human induced disturbance in tropical forest ecosystems. In the present project we address this issue by studying the effects of fragmentation on the trophic cascade "plant - leaf-cutting ant/fungus - predator/parasite" in the Brazilian Atlantic rainforest. We found a significant 6-fold increase in *Atta* colony density in forest fragments compared to the continuous control forest. We hypothesized, that the increase of colony density is a result of altered trophic interactions. In a fragmented forest more resources should become available for LCA through decreased plant diversity and dominance of pioneer plants with poor herbivore defense (i.e. bottom-up control). At the same time, through predator and parasite species loss, ant colony predation and parasitism rate should be decreased (top-down control). The results of the ongoing project revealed that in a fragmented forest LCA colonies have: 1) shorter foraging trails, and 2) narrower diet breadth, indicating less bottom-up control. Similarly, by now two top-down forces were found to be reduced in fragmented forests: 1) the attack of ant workers by parasitic phorid flies, and 2) the infection of the symbiotic fungus garden by a parasitic fungus species (*Trichoderma* spp.). The results indicate that the increase of leaf-cutting ant density through forest fragmentation is the result of altered trophic structure where both bottom-up as well as top-down forces may combine to additively affect the population of LCA's.

BE

Small genes for big problems – coping with challenges in Afrotropical amphibian diversity

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Several problems characterise the current biodiversity crisis in the tropics such as rapid loss and/or deterioration of habitats, general lack of taxonomic knowledge at the species level, loss of available taxonomic knowledge through retirement of specialists, and a remarkable amount of cryptic diversity. Rapid diversity assessment is required for the identification of conservation priorities in different areas. Molecular taxonomy can be an efficient supplement to classical taxonomy. Using Afrotropical amphibian communities, we examplify how in the framework of BIOTA the application of molecular data may help to rapidly identify (*i*) cryptic species, (*ii*) intraspecific morphological variation, (*iii*) non-identifyable larval stages, (*iv*) diagnostic morphological caracters, and (*v*) centres of phylogenetic diversity.

API

"Where are the shredders in the tropics?" - aquatic leaf litter decomposition in a global comparison

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Leaf litter is a major component in the organic matter budgets of streams worldwide. The decomposition of allochthonous organic material in streams is largely mediated by a functional feeding group of benthic invertebrates, so called shredders. However, various authors report a lack of this group in tropical streams. Several hypotheses which explain this phenomenon will be discussed, including the occurrence of more recalcitrant or even toxic leaves in tropical trees, biogeographical phenomena, wrong allocation of invertebrates to functional feeding groups, or the occurrence of other decomposition pathways than by invertebrates using own research data and global concepts.

FT

Spurenelement-Haushalt eines ecuadorianischen Bergwaldökosystems - Gibt es Hinweise auf Mangel?

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Als eine mögliche Ursache für den Kümmerwuchs tropischer Bergwälder wird Nährstoffmangel vermutet. Bisherige Arbeiten zu diesem Thema befassten sich vor allem mit Makronährstoffen. Es zeigte sich, dass viele Bergwälder möglicherweise N-limitiert sind. Dies gilt allerdings nicht grundsätzlich. Wir haben nun in einem Bergwald, in dem es keine Anzeichen für N-Mangel gibt, den Spurenelement-Haushalt untersucht.

Dazu haben wir einen Standort im Süden Ecuadors auf der ostexponierten Andenabdachung zwischen 1900 und 2200 m ü. NN mit ca. 2200 mm Jahresniederschlag ausgewählt. In drei ca. 10 ha großen Wassereinzugsgebieten bilanzieren wir seit April 1998 den Haushalt der Spurenelemente Mn, Zn und teilweise auch Cu. Dazu erfassen wir Quantität und chemische Qualität von Freiland- und Bestandesniederschlägen, Stammabläufen, Streuperkolaten, Bodenlösung und Oberflächenwasser in wöchentlicher Auflösung. Zusätzlich wurden Bodeneigenschaften aufgenommen und Element-Umsatzraten in der organischen Bodenauflage bestimmt.

Wir stellten fest, (1) dass Mn und Zn aus der Deposition in der Waldkrone aufgenommen wurden, (2) dass in schwach sauren Waldbodenauflagen (pH > 5,5) in Inkubationsexperimenten zugeführtes Mn und Zn netto immobilisiert wurde und (3) dass es während ausgeprägter Abflussereignisse infolge von Starkregen zu erheblichen Cu-, Mn- und Zn-Verlusten aus den Wassereinzugsgebieten mit dem Oberflächenabfluss kam. Von Natur aus niedrige Spurenelementgehalte im Boden und hohe Austräge aus den Einzugsgebieten führten zu einem geringen Spurennährstoffangebot für die Vegetation.

Unsere Ergebnisse zeigen, dass die Spurenelementversorgung des untersuchten Bergwaldes möglicherweise mangelhaft ist. Ob dies eine mögliche Ursache des Kümmerwuchses ist, kann allerdings nur mit gezielten Düngeexperimenten geklärt werden.

BS

Biodiversity gradients in soil-inhabiting fungal and algal associations along the BIOTA transect in Southern Africa

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A major goal of the BIOTA Southern Africa project is the analysis of biodiversity along a climate and vegetation gradient from the Cape Peninsula to Northern Namibia and the change of biodiversity in relation to abiotic factors, land use, and global change. Within the subprojects S03, S04 and S05, the diversity of organisms forming biological soil crusts as well as the diversity of soil-dwelling micro-organisms is investigated. Subproject S02 investigates soil properties and the distribution of soil patterns. In particular, four kinds of organisms are monitored: cyanobacteria, green algae, fungi and lichens. The general diversity of these organisms along the transect as well as the composition and architecture of soil communities has been analysed. First results describing the diversity and interactions of these organisms and their relation to soil properties on the BIOTA observatories are presented.

Most observatories along the transect were investigated, where cyanobacteria, algae, fungi and lichens were gathered according to different methods for subsequent examination in the laboratories. Floristic and ecological studies were carried out on lichen communities forming biological crusts by collecting specimens and taking digital images of relevés. Soil samples are examined for the presence of cyanobacteria, algae, micro-fungi and arbuscular mycorrhizal fungi, which are determinated by morphological and molecular biological methods.

There are first evidences of quantitative shifts and different patterns of species diversity and composition along the BIOTA transect, at least with regard to some of the examined groups of organisms. Their correlation with soil properties and the climate indicate their potential value as key taxa for long-term studies focusing on the intensity of land use.

BS

Biodiversity research: aspects linked to the diversity of small mammals and arthropods along a southern African transect – preliminary results of BIOTA S07

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In an ongoing study, our team examines the diversity of arthropods and small mammals on selected biodiversity observatories within the multidisciplinary BIOTA-Project. These observatories follow a transect from northern Namibia to western South Africa, thus including a variety of biomes, climatic conditions and different forms of land use.
A first evaluation of the Namibian transect has revealed differences in species richness and abundance between the observatories. An increase in the number of arthropod orders and of small mammal species was found towards the north along with an increase in the structural diversity and annual precipitation. The same applies to the diversity and abundance of arthropod herbivores.
Other ecological aspects of small mammals include trophic relations and reproduction. A detailed examination of the reproductive organs including sectioning and histological staining of potentially gravid uteri is currently under way. Initial analysis has shown that most small mammals on the transect have altricial offspring. Future work will test the hypothesis, whether species with precocial offspring are more abundant in the drier south of the Namibian transect.
In addition to these organismic investigations, a year round study of small mammal population dynamics was established on two adjacent observatories with striking differences in land use in October 2001. Up to now, both sites reached the highest diversity (Shannon-Wiener-Index: Nabaos Hs 0,708; GellapOst Hs 1,259) in May. The highly overgrazed site (Nabaos) consistently had a lower diversity in conjunction with a low overall abundance of small mammals compared to the less used site (GellapOst). There, the dominant species was found to be *Tatera leucogaster*, whereas *Gerbillurus vallinus* was the most abundant species in Nabaos.
For the future, it is planned to emphasize the aspect of the influences of human use by including more pairs of observatories with differences in land use and by experimental exclusion of livestock from parts of the study site. Another important aspect planned to be addressed in the future is the role of microhabitats in relation to the animals investigated. Small mammal burrows are of special interest since they not only alleviate temperature extremes but also provide shelter for the unweaned altricial offspring of lactating females.

CC/ED

Langzeitbeobachtungen an Epiphyten – ein Werkzeug zur Voraussage ihrer zukünftigen Populations- und Gemeinschaftsdynamik?

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Wie andere Organismen sind tropische Epiphyten nicht nur direkt durch grossflächige Habitatveränderungen und –zerstörungen bedroht, sondern auch durch weltweite Klimaveränderungen, die z.B. zu längeren Trockenzeiten oder zu häufigeren El Nino-Ereignissen führen könnten. Will man die mögliche Reaktion von Epiphytenpopulationen und –gemeinschaften auf solche Veränderungen voraussagen, brauchen wir einerseits möglichst detaillierte Beobachtungen über deren jetzige Populations- und Gemeinschaftsdynamik, andererseits aber begleitende Experimente, die zu einem mechanistischen Verständnis der zugrundeliegenden Prozesse führen. Während für tropische Holzgewächse solche Informationen in zunehmendem Masse zur Verfügung stehen, bleiben unsere Kenntnisse der Langzeitprozesse in Epiphytengemeinschaften weitgehend spekulativ. In meinem Vortrag werde ich eine Reihe von Langzeitprojekten im Tieflandwald von Panama vorstellen, die sich auf Populations- und Gemeinschaftsniveau mit diesen Fragen beschäftigen. So werden in einem inzwischen 6 Jahre laufenden Projekt die Populationsdynamik zweier Epiphytenarten detailliert studiert, und in zwei verschiedenen Dauerflächen zudem die Langzeitdynamik ganzer Gemeinschaften. In meinem Vortrag werde ich erste Ergebnisse dieser Langzeitstudien vorstellen und dabei die Frage diskutieren, ob die gewonnenen Erkenntnisse Voraussagen über die zukünftige Dynamik dieser für die Tropen so typischen Lebensform zulassen.

Abstracts der Poster

Dynamics of Rain Forest Margins in the Munessa Forest (South Ethiopia)

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A multidisciplinary team from Ethiopian and German research institutions (Addis Ababa University, Ethiopian Agricultural Research Organisation (EARO) and University of Bayreuth) tries to find ways to a better, more sustainable use of forests in South Ethiopia. The study area, the Munessa forest and his adjacent parts of the Rift Valley and the Arusi Mountains, is one of the rare natural forest remnants in South Ethiopia. Like in all Ethiopian forests, the growing pressure from the population living in and around the forest (and some plantations with exotic tree species) led to an ongoing forest degradation and a considerable loss of forested areas. For a better management of these forests, the extent and especially the reasons for these degradations have to be known.

Based on data from aerial photographs, satellite imagery and own observation in the field, we present some results concerning the different processes of forest degradation which lead to different dynamics. Interviews with the here living population but also with forest guards, foresters and the head of the governmental forest company explained the ongoing processes to a large extent. There is no general model concerning human influences and their consequences on the forest margins and therefore no general recommandation for protection and sustainable use can be given. Nevertheless, especially illegal tree felling and clearing for new settlements and agricultural fields and pastures contributed and still contribute to degradation and loss of forest cover. Only a better control of the forest remnants and substitutes for traditional forest products, coming from private plantations of exotic trees or from non-forest production, may moderate the actual pressure on the forests.

Our research is sponsored by the German Research Foundation (DFG)

Variation of specific diversity in a typical sudanian woodland according to the geometrical scale

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The study was conducted in an *Isoberlinia doka*-woodland in the Sudanian zone of Benin under various degrees of pasture pressure by bovine herds. The focus was laid on the determination of the species richness of woody plants (dbh = 5 cm), the species density for each scale level, the regeneration of the woody plants and also the life forms. The data were collected on plots of 10 ha, 1 ha, 0,1 ha and 0,01 ha. For calculating the species richness an inventory list of the woody plants (dbh = 5 cm) was established for each plot-size. Species density was ascertained in a 30 m x 30 m-plot with 5 repetitions within the plots of 10 ha, 1 ha and 0,1 ha and additionally in 5 sub-plots of 10 m x 10 m within the plot of 0,01 ha. For estimating the natural regeneration, seedlings and young plants of less than 5 cm in diameter were counted in 5 plots of 2 m x 2 m within the sites of the density investigations. Furthermore phenological observations (period of foliation, flowering and fructification) were conducted, the type of fruits (pods, drupes, bays and samaras) was noted and the productivity was determined. The results of these investigations will be presented on the poster.

The vegetation of Kakamega Forest - a result of human impact?

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Kakamega Forest is an isolated montane rainforest with numerous elements originating in the more wetter lowland forests of Uganda and the Congo basin. This easternmost relict of the guineo-congolian rainforest in Kenya covers today an area of 240 km². The main part of the forest can be divided into the northern Buyangu and in the southern Isecheno area. There are several fragments situated in the surroundings: In the north the fragments Malava and Kisere, in the south the two larger fragments Yala and Ikuywa with a small connection in between. The smallest fragment, Kaimosi, can be found in the south. All parts of the forest show different degrees of human disturbance within the last 100 years. The fragments vary in shape, in distance to the main forest as well as in distance to each other and in age. Beside climate, soil, habitat structure, degree of isolation and plant-animal-interactions, the main reason for the different vegetation types and the actual plant distribution is probably due to human impact.
The aspect of the forest is a mosaic which is dominated by different vegetation types. Disturbed and nearly undisturbed parts are present within a few meters distance. A true primary forest cannot be found. Only primary like forests with different degrees of disturbance could be recorded. The main part of Kakamega Forest consist of secondary forest.
The Kisere fragment shows he most undisturbed aspect. The upper tree layer reaches 25-30 m and many primary forest tree species like Aningeria altissima, Bequaertiodendron oblanceolatum, Chrysophyllum albidum and Strychnos usambarensis could be recorded. A rather dense shrub layer consisting mainly of Dracaena fragrans is typical for primary forest. The herb layer generally shows only low coverage. Dominant herbs are Pollia condensata, Dorstenia brownii and the seedlings of the lianas Hippocratea goetzii and Tiliacora funifera. In the past there was no high anthropogenic influence.
Other parts of the forest with a primary forest like vegetation are situated in the Buyangu Hill area and Colobus Trail. Until the early 1980's there was selective logging of tree species like Antiaris toxicaria, Prunus africana and Olea capensis. Within these forests many gaps occur with several typical gap tree species like Croton sylvaticus, Polyscias fulva and Celtis durandii. The canopy is much more open and there is a dense herb layer with a high coverage. In this herb layer several pioneer species like the herb Achyranthes aspera and seedlings of the tree species Funtumia africana are abundant. These gaps are indicators for selective logging over a long period and a higher degree of disturbance. This type of secondary forest can be found in Salazar area I and II.
Southeast of Buyangu Hill parts of young secondary forest could be recorded. In this area a shamba system existed with complete forest clearing which was abandoned 15 years ago. In the fragments of Malava and parts of Isecheno non indigenous tree species like Maesopsis eminii and indigenous like Prunus africana and Zanthoxylum gillettii were planted to recover the cleared parts. These species are now the dominant trees in this area.

Lepidopterendiversität im Verlauf der Waldregeneration am Kilimanjaro

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Im Rahmen des DFG-Projektes „Regeneration tropischer Bergregenwälder am Beispiel des Kilimanjaro" wurde entlang eines Höhentransektes von 1350 bis 3300 m am Südwesthang des Mt. Kilimanjaro auf insgesamt 50 Wald-, Baumheide- und Lichtungsflächen die Zusammensetzung der Nachtfaltergemeinschaften am Beispiel der Geometridae (Spanner) untersucht.

Als Index zur Beschreibung der Alpha-Diversität wurde Fishers Alpha gewählt. Die Alpha-Diversität der Geometridae nahm mit steigender Höhe ab, wobei über weite Höhenbereiche insbesondere zwischen 2000 und 3000 m keine Korrelation mit der Höhe zu erkennen war. Der höchste Wert von 40 wurde an einem Galeriewaldstandort auf 1350 m erreicht. In den parallel untersuchten naturnahen Galeriewäldern dieser Höhe schwankte der Wert für Fishers Alpha stark zwischen 26 und 40.

Im mittleren Bereich des Untersuchungsgebiet zwischen 2000 und 2300m wurden im ursprünglichen, sehr feuchten Naturwald deutlich geringere Diversitätswerte zwischen 5 und 8 ermittelt als auf umgebenden früheren Sukzessionsstadien. Die Werte lagen dort in den Sekundärwäldern zwischen 7 und 18, auf großen Lichtungsflächen zwischen 10 und 18. Insgesamt wurde hier eine Abnahme der Falterdiversität im Verlauf der Regeneration beobachtet.

Die Diversität der Geometridae am Kilimanjaro ist damit im Vergleich zu anderen tropischen Bergregionen sehr gering und entspricht insbesondere in Höhen oberhalb 1800 m eher den Werten, die für temperate Gebiete typisch sind.

Plant Cyanogenesis and its Relevance Concerning Herbivore-Plant Interactions

D. J. Ballhorn , R. Lieberei , J. Ganzhorn

Cyanogenic plants are able to release HCN as reaction to cell decompartmentalisation of cyanogenic tissues. The toxicity of the products of cyanogenesis as well as the fact that as precondition for the release of HCN an injury is needed, seems to argue for a defence function of plant cyanogenesis.

In this studies the relevance of plant cyanogenesis was analysed by feeding experiments with different cyanogenic cultivars of *Phaseolus lunatus* L. and the locust *Schistocerca gregaria*. Two aspects of plant cyanogenesis were considered:

1. The cyanogenic potential (HCNp); the entire cyanide quantity which can be released from a tissue containing cyanogenic precursors.
2. The cyanogenic capacity (HCNc); release of hydrogen cyanide quantity per time by a specific β-glucosidase, the linamarase.

The HCNp was determined by enzymatic release of HCN from the cyanogenic tissues. The release of HCN was continuously monitored after damage of leaf material by the herbivorous insects. Therefor a special equipment for cyanide detection was used in which the feeding experiments were accomplished. This equipment allowed to follow the time course of HCN release of HCN during the experiment.

Both, a high HCNp as well as a high HCNc of the leaf material showed a significant protective effect against excessive damage caused by the locusts. This protective effect was observed above a certain threshold of HCNp and HCNc, respectively, but it was independent of factors like development stages of the leaves or cultivar specific characteristics.

Seasonality of canopy arthropods of *Teclea nobilis* in Kakamega Forest, Kenya

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The influence of seasonal change on the faunal composition of canopy arthropod was studied in Kakamega Forest, a Guineo-Congolian seasonal rainforest in Western Kenya. Arthropods were collected by insecticidal tree fogging. Each eight trees of the abundant tree species *Teclea nobilis* growing in the same forest plot were fogged during the dry season in February 1999 and January 2002 and during the wet season in September/October 2001 and 2002. Arthropods were sorted to groups and counted, beetles were additionally identified or assigned to morphotypes. The results show significant differences in arthropod composition and in faunal overlap of beetles between seasons, but high overlap between different years at the same season. The abundance of arthropods is correlated with length and strength of the dry season, when arthropod numbers decrease. During the wet season the arthropod abundance increased. This might be attributed to the leaf flush period and the availability of food which is particularly important for phytophagous insects.

The ectomycorrhizal associations of *Uapaca spp.* (Euphorbiaceae)

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The trees of the genus *Uapaca* (Euphorbaceae) are known to form ectomycorrhizae, but until now, there doesn't exist clear evidence for a connection between the associated fungus and the tree root.

During two field trips to Cameroon's Southwest-Province, the fruit bodies of ectomycorrhizal fungi, growing in the vicinity of Uapaca spp., were collected. Ectomycorrhizae were isolated from the soil beneath the fruitbodies. For exact identification, DNA was extracted from both, the fruit bodies as well as the ectomycorrhizae and amplified by PCR, using fungus-specific primers. The obtained ITS region of the nuclear rDNA was compared by RFLP analysis.The morphological and anatomical features of the ectomycorrhizae were analyzed.

It could be shown, that the associated fungi belonged to the genera *Russula*, *Lactarius*, *Amanita*, *Cantharellus* and *Phylloporus*. The highest diversity was registered for the genus *Russula* with six clearly assigned species.

Top-down and bottom-up effects on survival and migration of a neotropical herbivore. Field experiments with nymphs of the stick insect *Metriophasma diocles*

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We studied top-down and bottom-up effects on first instar nymphs of the oligophagous stick insect, *Metriophasma diocles*. Prior investigations revealed that these herbivores are oligophagous specialists feeding on plants from the *Piperaceae* and *Araceae*, exclusively. In the tropical moist forest forest of Barro Colorado Island (Panama) they occur in low abundances.
The purpose of this study was (1) to quantify top-down pressure on stick insect nymphs and (2) to directly link migratory activity of nymphs to predation avoidance or (3) to bottom-up factors, in particular to food availability.
We performed four 2-week long exclusion experiments following survival and migratory activity of a total of 238 nymphs in exclosures and controls during the rainy season. The exclusion of predators resulted in an almost threefold higher survival (69%) compared to nymphs on control plants (24%). As predation was significantly higher at night, birds can be excluded as relevant predators of these herbivores and motivate further studies to discriminate between nocturnal and diurnal predation rates.
After considering intrinsic mortality factors we estimated that 45% of the nymphs in controls died through predation. This is the first quantification of predation pressure on nymphs of hemimetabolous insects and within the range reported for holometabolous herbivores.
The rates of migration of nymphs off of plants could not be explained by the presence of predators and consequently does not reflect predation avoidance. Instead, we found evidence that emigration of nymphs was triggered by food availability.
In conclusion we state that top-down pressure in this system affects the abundance of *M. diocles* severely, whereas bottom-up forces may rather determine the herbivore's distribution.

Patterns of predation pressure on a neotropical herbivore

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We studied top-down effects on first instar nymphs of the oligophagous stick insect, *Metriophasma diocles*. The purpose of this study was (1) to quantify top-down pressure on stick insect nymphs, and (2) to assess spatio-temporal patterns in predation rates.
We performed four 2-week long exclusion experiments in the forest of Barro Colorado Island, Panama. In total we followed survival of 238 nymphs in exclosures and controls during the rainy season.
The exclusion of predators resulted in an almost threefold higher survival (69%) compared to nymphs on control plants (24%). After considering intrinsic mortality factors we estimated that 45% of the nymphs in controls died due to predation. This is the first quantification of predation pressure on nymphs of hemimetabolous insects and is within the range reported for holometabolous herbivores.
Mortality was temporarily and spatially heterogeneous. The effects of predation were significantly increased at night. As a consequence, we concluded that birds as one prominent predator group were not responsible for predation on these herbivores and encourage further studies to discriminate between nocturnal and diurnal predation rates. Survival did not differ between runs in the exclosures, but was highly and significantly different between runs in the controls. Hence short term observations about predation pressure on insect larva may only inadequately approach predation impact during larval development. Spatial effects of predation differed to a lower extent. Mortality in the controls varied between plots indicating locally increased predation pressure.

Plant-pollinator interactions in East African rainforest fragments

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It is widely recognized that fragmentation of natural habitats not only affects the distribution and the abundance of organisms, but important biological processes like pollination as well. In this project we analyse the alterations in plant-pollinator interactions caused by habitat fragmentation and the consequences for the long-term maintenance of tropical biodiversity. The study is carried out at the Kakamega Forest, Western Kenya, where we compare pollination interactions of five different sized forest fragments to continous forest. In all forest plots we collect data of the different levels of pollination, i.e., frequency of flower visits, primary pollination success, fruit production rate and seed production. So far, our studies concentrated on understory species. Preliminary data show that forest fragments and continuous forest differ in the mentioned parameters. However, as yet, a consistent pattern could not be demonstrated.

This study is part of the BIOTA-East Africa program and supported by the German Ministry of Education and Research.

Diversity of ground-dwelling ants in secondary woodlands of southern Brazil

Bihn, J. H., Verhaagh, M., Engels, W.

Tropical forests are one of the centers of global biodiversity. However, these ecosystems are being rapidly degraded and converted into land use systems what very likely causes the extinction of many forest species. To what extent secondary forests can serve as habitat substitutes for species out of primary forests is not yet well known.
We compared the diversity of ground dwelling ants in a secondary mixed forest with an Eucalyptus plantation in southern Brazil - two habitats that had been subjected to different degrees of human intervention. We hypothesized that the diversity of ground dwelling ants would be lower in the Eucalyptus plantation than in the secondary mixed forest because of the plantation's more homogenous vegetation. In each of the two sampling sites, we took 18 litter samples (1 m^2) from which we extracted the ants using the Winkler-method.
In total, we found 24001 ants representing 74 (morpho-)species. In comparison to the Eucalyptus plantation, species richness (observed and extrapolated) and species evenness were higher in the secondary mixed forest site, although differences were small. The same small differences were also characteristic for the species composition of the sites. Both, the density of individual ants and ant species density were significantly higher in litter samples out of the secondary mixed forest than out of the Eucalyptus plantation.
Our results emphasize that secondary forests can maintain a high diversity of ground living ants. Even agroforestry systems like Eucalyptus plantations seem to be a suitable habitat for many ground-dwelling ant species and may play an important role for biodiversity management in tropical landscapes.

Auswirkungen des El Niño 97/98 auf die Vegetation in der Sechura-Wüste (Nordperu)

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In einer langfristig angelegten Studie werden die Auswirkungen des El Niño-Phänomens auf die Vegetation in der Sechura-Wüste (Nordperu) untersucht. Das Gebiet zählt bezogen auf die interannuellen Regenanomalien zu den sensitivsten Gebieten der Erde. Hier erhalten die trockenen Küstensäume in den Sommermonaten extremer ENSO-Jahre die höchsten Niederschlagsüberschüsse mit bis zu 9000% gegenüber einem NON-ENSO-Jahr. - In fünf Testgebieten mit insgesamt 25 Dauerquadraten werden seit 1997 (also schon vor dem Ereignis einsetzend) zwei mal jährlich die Artenzusammensetzung und deren Abundanz sowie Dominanz aufgenommen. Die Testgebiete folgen dem Klimagradienten von der ariden Küstenwüste bis zur semiariden Baumsavanne im Landesinneren.

Die beobachtete starke Zunahme der Vegetationsbedeckung nach den Regenfällen ist auffallend, wenn auch nicht unerwartet - die sogenannten „blühenden Wüsten" sind ein bekanntes Phänomen. Überraschender ist dagegen die Erkenntnis, daß die erhöhten Niederschläge über die Brücke einer erhöhten Pflanzen- bzw. Strohproduktion auch zu vermehrten Bränden mit einer eigenen Folgevegetation führt; ebenso deuten sich Auswirkungen der kühleren La Niña-Phase auf das Florenspektrum aus. Schließlich ist davon auszugehen, dass durch die starken positiven Niederschlagsabweichungen während El Niño außer dem kurzfristigen Auftreten von Therophyten ebenso eine langfristige Dynamik auftritt, die neben zyklischen auch gerichtete Veränderungen bewirkt. Kleinere Regenfälle in Jahren nach einem Niño-Ereignis reichen aus, um in Gang gesetzte Regenerationsprozesse zu erhalten, sodass vor allem der Aufwuchs von Holzarten langfristig beeinflußt wird. Eine quantitative wie auch qualitative Veränderung der Vegetation zeichnet sich ab.

Tree-Management on Successful Farms: a Case Study from Tanzania and Kenya

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18 successful, partly female-headed small-scale farms located in two project areas in Tanzania and one in Kenya have been investigated with regard to farmer's strategies and activities within the context of natural resource management and related aspects. A multimethod approach has been applied with main focus on participant observation. Data have been collected during on-farm stays of up to 7 days on each farm. Additionally, self-help group meetings have been attended, structured expert interviews been carried out and other farms been visited.

Tree management forms an important aspect within the frame of natural resource management and livelihood strategies. Trees and shrubs fulfil multiple purposes on the selected, well-managed farms. In total, 152 different species have been assessed and grouped after exotic and indigenous species as well as fruit and non-fruit species.

The research shows various tree management patterns as to species selection, use aspects and location. These variations are due to individual preferences and interests, but are also determined through project influence and agro-ecological zone.

Variations in leaf traits among co-existing tree species of different land use systems in Sulawesi, Indonesia

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Land use at the rain forest margin of the Lore Lindu National Park in Sulawesi (Indonesia) changes rapidly. Old-growth forest is converted to other land use types such as annual crops and cocoa plantations. Secondary forests can establish on former rain forest land after abandonment of agricultural activities. With these changes also the tree species composition and functional diversity of trees such as gas exchange characteristics are altered. Gas exchange at the leaf level has often been found to be correlated to various leaf traits. We have studied the variability of leaf traits of tree species occurring in three different land-use systems: old-growth forest, young secondary forest and cocoa plantation with shadow trees. Sun leaves were collected from randomly chosen trees. The studied leaf traits include nutrient contents (N, Ca, K, Mg, P), $d^{13}C$ and $d^{15}N$ signature and morphological characteristics (leaf size, specific leaf area, stomatal density). First results indicate that the variability of leaf traits among tree species occurring in the old-growth forest was larger than in the secondary forest. Although composed of only three woody species the agroforestry systems showed a considerable variability of leaf traits.

Phytosociological Analysis of a Secondary Tropical Mountain Forest in the Reserva Biológica San Francisco, South Ecuador

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A secondary forest, about 40 years old, adjacent to the "Sendero Canal"-clearing was investigated comparatively by transect and plot analysis. Using the Braun-Blanquet method, relevés of individual subplots of 5 x 5 m were established and the vegetation structure of these subplots was drawn to scale. In total, 73 subplots were investigated in this way. The relevés were clustered using the programme SORT, Version 4.0, and grouped to delineate patches of different types and developmental stages of secondary forest. In the 140 m long vertical and the 60 m long horizontal transects changes of the vegetation were traced by the calculation of the Sœrensen similarity index. Four types of secondary forest were suggested along the vertical transect, starting with a heavily and obviously recurrently disturbed forest, followed by a forest type with predominant pioneer species and another patch of forest exhibiting characters of repeated tree felling. Finally, close to the edge of the primary forest, another type was encountered with a significant contribution of pristine forest species. Analysis of the total plot of 1500 m² showed a high degree of heterogeneity which is typical of secondary forest, where a minimum area could not be achieved. However, based on the occurrence of agriculturally used species, the former use of part of the area could be reconstructed. In the vicinity of the ruins of a house a former home-garden could be traced and in addition to this a plot of former pasture land became obvious by the abundance of typical pasture grasses.
While transect analysis provided a useful overview of the area and the various developmental stages of the secondary forest, more insight in the recent history of the forest can only be obtained from the analysis of the unbroken plot.

Capacity Building and Co-operation within BIOTA West 1. Regional Workshop in Abidjan and Multidisciplinary Excursion to the newly built Station de Recherche Ecologique, Comoé National Parc, 10-16 September 2002, Côte d'Ivoire

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The first regional meeting of BIOTA West took place in September 2002 in Abidjan, Côte d'Ivoire. Throughout three days, from 10-13 September 2002, the aims of BIOTA with all its subprojects was presented and discussed with more than 70 participants from the four participating countries of BIOTA West (Bénin, Burkina Faso, Côte d'Ivoire and Germany).

After the opening ceremony by the project leader, the mayor, the leader of the Goethe Institute and the Ivorian Minister of Science, Research and Technology, the responsible German subproject leaders introduced their projects in nine lectures. The morning of the second day was reserved for our counterparts. Beginning with talks from our actual counterparts from Benin and Burkina Faso the projects already involved in BIOTA were presented as well as new project ideas proposed. Based on these talks and taking old and new concepts into account the perspectives for the main phase were discussed during the afternoon. During these discussions several new concepts emerged and were elaborated on in some detail. In addition, new co-operative ventures were planned. The following morning we continued with our productive discussions until the workshop ended with the official finishing ceremony by the "Directeur du Cabinet" of the Ivorian Ministry for Environment.

The reactions vis-à-vis the presentation of the BIOTA West program in Abidjan were very positive. Not only the presence of two high-ranking representatives of the government for the opening and the finishing ceremonies emphasised the status of the project in the country, also the echo in the Ivorian media, TV and radio, underlined the importance of research projects such as BIOTA in the respective countries of West Africa. The number of participants, especially of interested students, was much higher than expected. The meeting has to be considered a big success: a huge step forward in the reception of the aims of BIOTA, towards an optimal acceptance in the country and in furthering a still closer co-operation with our African counterparts.

After the workshop 40 of the workshop participants, including our counterparts from Burkina Faso and Benin and most of the German researchers attended a four day field excursion to the nearly completed 'Station de Recherche Ecologique' in the Comoé National Parc. During the participants' stay at our Ecological Station and on the occasion of different field excursions we had the opportunity to continue our scientific discussions and to enhance our co-operative plans for BIOTA's main phase. The benefit of this multidisciplinary field excursion for the project and especially for the participating African students was very high.

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Diversity of Namibian dragonflies: modelling the population dynamics along a habitat gradient

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In arid regions like Namibia, water is one of the most limiting factors for humans as well as for animals and plants. Changes in the water balance – either on small scale by using water for the local communities or on large scale through countrywide modifications of the climate – may lead to significant change in biodiversity. Monitoring of indicator organisms offers a possibility to assess sustainable water management.
The existence of dragonflies depends on water because some parts of their life cycle take place in an aquatic environment. They occur in the ephemeral ponds in the Namib desert and therefore are best suited as indicators for water quality and quantity.
We present a model for the population dynamics of dragonflies based on an extended Leslie-matrix. We depict the life cycle of the dragonflies with different stages: Egg, several distinct larvae stages, immature adults and mature adults. Each stage is age-structured. One of the main factors determining the population dynamics is the diet of the dragonflies. Reducing the unspecific food leads to increasing competition and cannibalism between the different larvae stages causing a high level of feedback loops. We take these coherences into account by formulating the transition between different stages as dependent on available food.
Additionally, we combine the results of habitat suitability models with the population dynamic model. The habitat suitability models for different species of the Karoo are based on logistic regression. They show that widespread dragonfly species exhibit more or less unspecific habitat requirements depending on their behavioural strategy. So migrating species like *Pantala flavescens* e.g. obviously have no high demands concerning vegetation structure. In contrast, for *Crocothemis erythraea* the probability of occurrence is much higher for habitats with high vegetation diversity comparing to habitats with less vegetation. In our model the survival probabilities were adapted to the respective degree of habitat dependency.
The presented model for the population dynamics reflects the life-cycle of the dragonflies and does not contain any explicit spatial aspect. Small-scale dispersal can be modelled via a cellular automaton. In each cell a population dynamic is calculated including temporal variability of the habitat quality. The dispersal of the odonata populations is modelled by setting up neighbourhood relations between the cells. So the preseneted model will serve as a base for a spatially explicit dispersal model.

Primary and Secondary Introductions of the Western Honeybee Apis mellifera on a Global Scale

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The natural distribution of the western honeybee, *Apis mellifera,* is restricted to Europe and Africa where 26 subspecies have been identified by Ruttner (1988) and Hepburn (1998). Through human transportation a wave of primary introductions brought honeybees into the Americas, Australia, New Zealand, Japan and Asia from the 18th century onward. These primary introductions are still going on in the 21st century on a global scale. In addition to these a new kind of secondary introductions has occurred since 1990 in which honeybees of European origin but bred in Australia, New Zealand and North America have been reintroduced into various regions of Europe and Africa (the endemic area of distribution of *Apis mellifera*).

These introductions lead to phenomena of hybridization and competition between endemic and introduced subspecies. The case of the 'africanized honeybee' in South America has produced a serious problem to public health and beekeeping on this continent. In order to avoid negative impact of introductions of honeybees, an environmental evaluation should precede each new introduction (primary or secondary) in order to estimate the possible benefits and costs of the introduction to the new environment. For this purpose a new organizational effort needs to be undertaken on a global scale.

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Semi-decadal Land-Use Change in the Alto Mayo Valley, Peru

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Rapid land use change by small scale farming is the main cause of deforestation in the Alto Mayo Valley in Northern Peru. The large flat valley at the Eastern slope of the Andes attracts many peasants from the Andean highlands because of its relatively fertile soils for rice cultivation. As a secondary effect of the valley development, adjacent hill areas and the steeper valley slopes are now cleared for coffee cultivation. The continuing influx of small farmers results in a rapid and still largely uncontrolled conversion of pristine neotropical forests into pasture and agricultural areas. Up to present, no analysis of the rate of land conversion was available for the region and the amount of abandoned areas which are secondary shrubland or forests is not well known.

To monitor the land use conversion process, a land-use change map for the upper Rio Mayo watershed in Northern Peru was generated. The map was based on bi-temporal Landsat-TM satellite imagery. Two LANDSAT images from 1995 and 2000 were geo-referenced and analyzed. Five land cover units, primary forest, secondary forest, agriculture, pasture, and urban areas were defined within the boundaries of the 768 000 ha study site and verified in the field. The aim was to quantify the rate of deforestation as well as the extension of abandoned agricultural areas and pastures. Of special interest was the loss of primary rain forest at the edges of the large protected upper valley catchment.

In addition to the semi-decadal land use change estimation for the entire valley, a biomass stock estimate for the forested areas was made. The present forest biomass in the region was calculated using field data available from a study on primary and secondary forest types, forest soils, aboveground biomass and nutrient stocks in the same region.

Ecology and biodiversity of macrofungi in the Mbalmayo Forest Reserve-Cameroon

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The Mbalmayo forest reserve is estimated to 9900 hectares. Up today 40% of this forest are degraded, and have been converted from forest into agricultural or grazing lands (ONADEF, 2002). The main causes for deforestation and land conversion have been the contribution of wild plants to household economies, the gathering of fuelwood and agricultural activities, in this latter case, slash-and-burn cultivation is a method commonly used to clear the land. This eventually occurs with destruction of microclimate and fungal mycelium; many fungi species being litter-or wood-inhabitants, the land use affects their biodiversity and distribution. To assess this impact of land conversion on mycogeography and mycodiversity, floristic surveys were carried out in different land use systems (original forest, logging residues, fallows, crop fields) within the reserve with special focus on substrate nature. Fungi samples were collected in 2001 (March to June) and 2002 (April to May and September to October). The results showed that the forest areas preserve the greatest biodiversity, mostly saprophytic species, the most diverse taxonomic groups were Aphylloporales (60%) and gilled fungi of the family Tricholomataceae (32%). These results also indicated that in the crop fields many saprophytic and mostly lucifuge taxa such as numerous Tricholomataceae (Marasmioid and Mycenoid fungi), non gilled fungi as Polyporales, Ascomycetes, are very sparse or lacking. Species richness is reduced progressively from the original forest (49%), to the fallow fields (30%) and to the crop fields (21%) where mostly terricolous and saprophytic gilled fungi contribute essentially to fungal biodiversity. A floristic and quantitative comparison of the different land use systems indicates an overlap (species occurring at many sites) and some species are obviously restricted to the natural forest.

Regional dominance and diversity of woody liana communities in NW Amazonia

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Diversity and distribution of woody lianas (DBH $\geq$ 2.5 cm) in northwestern (NW) Amazonia were studied in three different regions: middle Caquetá basin in Colombia, Yasuní area in Ecuador, and Maynas Province in Peru. The principal landscape units considered were well-drained flood plains, swamps, and well-drained uplands (tierra firme). 56 plots (0.1 ha each) with more than 25 individuals of lianas were used for the analysis. Two-way ANOVA and ordination techniques were employed to analyze liana patterns in relationship to environment and space. 42 families, 117 genera and 249 species were found. The most diverse families were Leguminosae (47 species), Bignoniaceae (40 species), and Malpighiaceae (30 species). *Combretum laxum* and *Machaerium cuspidatum* were abundant in the three regions. Between regions or landscapes, there were no differences with respect to the number of individuals. However, the number of families, genera, species richness, and diversity (Fisher's Alpha index) differed between these factors. Liana diversity was higher in well-drained uplands than in flood plains and swamps, and was higher in Maynas province in Peru than elsewhere. PCoA ordination diagram showed that the floristic composition of woody liana was more determined by region than by landscape. Liana abundance and diversity did not show any relationship with soil fertility. Within regions flooding was an important factor for liana composition.

Seed dispersal efficiency of flying foxes for Cola cordifolia (Sterculiaceae)

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Flying foxes (Megachiroptera) are known for their frugivorous feeding habits and their potential to disperse seeds. In recent years it has become more and more important to look beyond mere seed transport, leading to investigations addressing the question of whether and how different frugivores might affect establishment success and regeneration of plant populations. Our study aims at determining how fruit selection and handling, seed handling and habitat selection affect germination, seedling establishment and sapling growth and survival (Gondinez-Alvarez 2002) within a highly seasonal forest-savannah mosaic system. We take both the quantity and quality components of seed dispersal (Schupp 1993) into consideration. However, due to time constraints we are limited in our conclusions more to aspects pertaining to quantity than to quality of dispersal.

Flying foxes are highly mobile mammals with high energy requirements (Thomas 1984). Several species are also known to migrate. Due to their high mobility and energy demands we expect to find high visitation rates of Megachiroptera at fruiting trees and high fruit consumption rates combined with variable and potentially long dispersal distances. Local species richness and abundance of flying foxes should be highest during periods of peak fruit production leading to high dispersal rates. In addition to the quantitative aspect of seed dispersal we also addressed qualitative aspects by investigating the effects that their feeding behaviour, in particular fruit removal from parent trees, has on the distribution of seeds and how this enhances germination and establishment success of *Cola cordifolia*. To determine the main direction in which seed dispersal is taking place (sensu Janzen 1970, Connell 1971) we generated seed dispersal kernels. By investigating the spatial distribution of the seeds in relation to saplings and adults with point pattern spatial analysis, we determined recruitment dynamics.

We found that flying foxes disperse seeds without harming them at varying distances away from parent in areas of low adult density. We conclude that dispersal away from the parent trees by flying foxes can contribute substantially to successful establishment.

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Diversity of epiphytic lichens and bryophytes on Mount Kenya

Comparison of natural and anthropogenic habitat fragmentaion along an altitudinal rainforest transect

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The forests of Mt. Kenya can be roughly divided into three altitudinal zones: The *Hagenia abyssinica-Juniperus procera* forest from 3000 – 2900 m, the *Sinarundinaria alpina* forest from 2900 – 2500 m and the montane rainforest from 2500 – 1800 m. In each of these three zones the epiphytic lichen and bryophyte vegetation was studied on the stems and additionally on fallen branches from the canopy by using the phytosociological method of Braun-Blanquet. The rélévés were established along a transect on the Chogoria-side at intervalls of 100 m altitude.

Due to the influence of buffalos and elephants the *Hagenia-Juniperus* zone consists of isolated forest patches surrounded by grassland and swamps. The main phorophytes are *Hagenia abyssinica, Juniperus procera, Podocarpus latifolius* and *Stoebe kilimandscharica*. The epiphytic lichen vegetation was dominated by different *Usnea-, Heterodermia-, Leptogium-* and *Parmotrema*-species. Other characteristic taxa are *Lobaria pulmonaria, Pseudocyphellaria aurata* and *P. crocata*, various *Sticta*-species and calicioid lichens. The bryophyte vegetation was dominated by *Antitricha kilimandscharica, Leucodon-, Leptodontium-, Hypnum-* and *Frullania*-species.
The *Sinarundinaria alpina*-forest consists of dense, species-poor stands of bamboo with scattered *Podocarpus*. In spite of large buffalo and elephant populations there was mainly closed canopy forest. The main phorophytes are *Sinarundinaria alpina* and *Podocarpus latifolius*. The epiphytic lichen vegetation was characterized by crustose species. Foliose and fruticose taxa like *Parmotrema, Bulbothrix, Cetrariastrum sorocheilum* and *Heterodermia leucomelos* were either restricted to bamboo nodes or the canopy. Here also several *Usnea*-species could be recorded. The bryophyte vegetation was dominated by small liverworts (*Metzgeria-, Lejeunea-, Microlejeunea-* and *Aphanolejeunea*-species).
Within the montane rainforest zone different communities and different degradation types were investigated. In the upper part above 2200 m primary forests still exist, while in the lower part the forests were heavily influenced by logging of *Ocotea*-trees. The main phorophytes are *Ocotea usambarensis, Tabernaemontana stapfiana* and *Xymalos monospora* in the primary forest and *Neoboutonia macrocalyx, Macaranga kilimandscharica, Myrianthus holstii, Zanthoxylum gilletii* and *Harungana madagascariensis* in the secondary forest. In primary forests the epiphytic stem vegetation was dominated by bryophytes (*Plagiochila-, Neckera-, Porothamnium-* and *Pilotrichella*-species). Lichens were mainly represented by different crustose taxa, *Phyllopsora*-species and genera with blue-green photobiont (e.g. *Leptogium, Sticta*). Foliose and fruticose lichens were mainly restricted to the canopy (e.g. *Parmotrema, Ramalina, Usnea*). In contrast to these observations the secondary forests are characterized by the abundance of desiccation tolerant bryophytes and foliose and fruticose lichens.

The Importance of Refuge-areas for Small Vertebrates in Grazed Habitat in the Australian Arid Zone

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Natural refuge-areas are essential for many species in infertile landscapes to survive droughts. When managers keep high stocking rates through droughts, these stock are likely to alter the vegetation in these ecologically important natural refuge-areas and thus cause a loss of habitat for animals depending on them for survival.

Chenopod shrublands constitute of the major sheep grazing pastures of western New South Wales (NSW) and belong to the most severely degenerated habitats in arid Australia. Since European settlement 32 species (42%) of mammals inhibiting the arid zone of Australia have become extinct. Whereas the response of small mammals to grazing and their importance in conservation is well studied, effects of livestock grazing on the herpetofauna of the Western Division of NSW are largely unknown. In contrast to mammals no reptile has become extinct since European settlement in the arid zone of Australia, but there are suggestions that declines in the abundance of reptiles are expected to follow a similar pattern to that of mammals.

Between end of October 2001 and February 2002 my study investigated the effect of two different habitats (grazed and ungrazed) on the diversity, composition and abundance of reptile and small mammal species by using 96 pit fall traps in chenopod shrubland in western NSW, 112 km north of Broken Hill. Ungrazed sites where situated in an enclosure (12.5 ha) and have remained free of stock (sheep), feral goats and relatively free of rabbits since 1977. Kangaroos have been released into the enclosure for short periods during irregular experiments and so have lightly grazed the vegetation. The enclosure is fenced off with 2 m high wire mesh, which does not strictly exclude feral predators, cats and foxes. The effect of differences in vegetation and of the availability of invertebrates were used to explain patterns of reptile and mammal occurrence.

The significant higher abundance of 3 reptile species inside the enclosure and a dense and healthy breeding population of the marsupial mouse *Sminthopsis macroura* (which is listed as vulnerable in NSW) only inside the enclosure let suggest that a dense vegetation cover is enough to compensate for a moderate pressure by feral animals.

The importance of refuge-areas for small vertebrates in grazed habitat for regional management at individual paddock and property-scale in cooperation with land users will be discussed.

Biogeography of lemurs in Madagascar: the role of geological history, elevational distribution, and rivers

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An implicit theme in biogeographic analyses of lemurs is that the pattern and evolution of vegetation communities should have an important bearing on their distribution. However, an historical bias may complicate these comparisons. Traditional views of the phytogeography of Madagascar have divided the island into the extremes of the dry west and humid east. This is in part a result of the intermediate zone, the central highlands, being cleared of most of its original forest since the start of biotic exploration of the island. This void of information from the central area may have artificially accentuated perceived differences between the eastern and western portions of Madagascar. Recent biological inventories in the western portions of the central highlands clearly show that this zone has a mixture of eastern and western biotic elements. Further, molecular studies of lemurs and other vertebrates indicate that the classically interpreted east-west biogeographic division may not reflect a common pattern of speciation amongst numerous organisms. Here we take a different approach to explain some aspects of the distribution of extant lemurs by examining the geological history of the island with regards to available habitat since the evolution of prosimians and the importance of rivers as barriers to dispersal and speciation. Supported by the VW-Stiftung.

Bodenmykozönosen ausgewählter Standorte Namibias - Soil mycocoenoses of selected areas of Namibia

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In the framework of Biota Southern Africa the diversity of soil fungi and arbuscular mycorrhiza along a transect from Cape Town to the Namibian/Angolan border is investigated. The presented paper shows results gained by monitoring the above mentioned fungi on the biodiversity observatories Mile 46/Mutompo and Toggekry/Otjiamongombe located in tropical Namibia. Each observatory consists of plots under different land use. Located in the dry forest of northern Namibia, Mile 46 is a research station, Mutompo is communal land used for extensive cattle grazing, both sites located in dry forest. In the Middle of Namibia are the two farms Toggekry and Otjiamongombe, both in the thornbush savanna. Otjiamongombe is managed as a cattle farm and Toggekry is a game farm. From all sites soil samples are taken, washed in the lab, sieved for VA-spores and soil fungi are isolated. Additionally root samples are examined using morphological and molecular methods.

Arbuscular mycorrhizae were found to be very diverse, out of approximately 160 described species, spores of 18 species were reported from Mile 46/Mutompo, 14 from Toggekry/Otjiamongombe. Spore counts and mycorrhization rate are statistically not different between sites; no influence of land use can be detected. Analysis of arbuscular mycorrhizal sequences from grass roots shows that the diversity of spores is not mirrored in the diversity of sequences from grass roots. This suggests that either roots of forbs, shrubs or trees support other arbuscular mycorrhizal fungi than grasses or that the AM-community within the roots changes during the year. In the sequence analysis, no clades that are unique to land use systems can be found, but some clades are missing from the samples from Toggekry/Otjiamongombe.

Among the isolated Zygomycetes *Rhizopus microsporus* is the dominating species in Mile 46/Mutompo. In that area there is no proof for the genus *Cunninghamella*, which occurs in Toggekry/Otjiamongombe with two species, *C. elegans* and *C. echinulata*. Generally many Aspergilli are isolated, however the frequency in Toggekry/Otjiamongombe is lower than in Mile 46/Mutompo. In half of the soil samples in Mile 46/Mutompo *A. niger* respectivly *A. japonicus* is observed. These two fungi are not isolated from Toggekry/Otjiamongombe. Another species isolated from Mile 46/Mutompo but not isolated from Toggekry/Otjiamongombe is *Neocosmospora vasinfecta* var. *africana*. At the moment there is no important difference between the different land use systems observed.

All the above results seem to indicate that the most important factor controlling diversity of arbuscular mycorrhiza and soil fungi is not land use, but either climate or diversity of vegetation.

Bewertung des traditionellen Nutzungsdruckes auf die Biodiversität im Chiquitano-Trockenwald, Bolivien

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In Zusammenarbeit mit der Fundación Amigos de la Naturaleza Noel Kemmpf und der Fundación para la Conservación del Bosque Seco Chiquitano, Santa Cruz de la Sierra, Bolivien.

Im Dezember 2000 wurde eine Gasleitung zwischen San Miguel (Bolivien) und Cuiabá (Brasilien) in Betrieb genommen, die das Trockenwaldgebiet „Bosque Seco Chiquitano" durchquert.

Der Chiquitano-Trockenwald stellt zusammen mit den Ökosystemen des Pantanal, des Cerrado und des Gran Chaco die Chiquitania-Region dar. Diese befindet sich im östlichen Teil des bolivianischen Departamento Santa Cruz, nahe der brasilianischen Grenze.
Die Bedeutung des Chiquitano-Trockenwaldes für Bolivien und für die Welt besteht sowohl in ökologischen als auch ökonomischen Aspekten. Er ist der einzige endemische Waldtyp Boliviens und umfasst eine unzerschnittene Landschaft, welche immer noch die Lebensfähigkeit der Individuen und eine hohe Biodiversität gewährleistet. In dieser Ökoregion wurden 8 unterschiediliche Vegetationsformationen (Unidades) bestimmt, in denen 551 Pflanzenarten (Gullién et al. 2002) und 772 Tierarten (MHNNK, 2001) vorkommen.
Die Region ist sehr dünn besiedelt. In dem Teil des Chiquitano-Trockenwaldes, den die Pipeline durchquert, liegen vier Dörfer. Im Rahmen des Forschungsprojektes *„GIS gestütztes Monitoring-& Evaluierungssystem der indirekten Umweltauswirkungen von Pipelines am Beispiel des Chiquitano-Waldes, Santa Cruz - Bolivien, und der Pipeline San Miguel - Cuibá"* wurden im Jahr 2002 Primärdaten über die Dörfer im Einflussbereich dieser Pipeline erhoben. Es wurden zwei Fallstudien durchgeführt, um die traditionelle Ressourcennutzung der einheimischen Bevölkerung zu beschreiben und die Einflüsse der Pipeline auf die Ressourcennutzung zu dokumentieren. Zuvor wurde in einem weiteren Dorf eine Vorstudie zur Validierung der Fragebögen angefertigt. Insgesamt haben mehrere Feldaufenthalte vor Ort stattgefunden. Die Erhebung der Information wurde auf Haushaltsniveau gemacht. Erste Ergebnisse werden unter Verwendung deskriptiver Statistik dargestellt.

Successional patterns in a semi-arid zone of the Colombian Andes: Implications for restoration

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A study on vegetation patterns in a semi-arid zone in the High Plain of Bogotá (Colombia) is presented, as a basis for a restoration experiment in the dry Andean dwarf forest zone. We aimed at explaining species patterns by means of environmental, spatial, and disturbance history data. Moreover, we explore the successional position of nine woody species used in a restoration experiment. We laid out 101 relevees in grassland and shrubland types in different stages of recovery, and in relatively little disturbed dwarf forest. The disturbance history over the last ~60 years was inferred from aerial photograph series (1941-1991). A relevee classification by means of TWINSPAN resulted in seven types, supported by a DCA. Partial CCA was applied to relate species composition to environmental data (height, slope, soil characteristics), disturbance history, and to the spatial configuration of the relevees. Abiotic factors most related to species composition are nutrient richness, alkalinity and organic matter content. Many former pasturelands have been abandoned and permitted invasion of low scrubs. Recovery is very slow, and the revealed trends only slightly govern present-day species patterns. Spatial patterns, on the other hand, are clear; fragmentation could inhibit recovery of woody vegetation. Invasion of grasslands by woody species is pioneered by *Baccharis bogotensis*, and, depending on soil characteristics, *Dodonaea viscosa* (dry sandy slopes). *Dalea coerulea* is the predominant woody species of truncated clayey soils, which will probably not support *Condalia* dwarf forest, but will stop developing in the *B. bogotensis – D. coerulea* stage.

Biodiversity in African Dragonflies – population genetics and cryptic speciation

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While Dragonflies are model organisms for behavioral ecology, they also may serve as bioindicators for evaluating the quality of freshwater ecosystems. Dragonfly biodiversity can be particularly helpful in understanding the impacts of ongoing anthropogenic development because different species live in a wide variety of habitats. Therefore, knowledge of genetic diversity is crucial for conservation management of Odonates. The degree of variation within a gene pool cannot be monitored at the organismic level and molecular methods have become indispensable tools for assessing population structures. We have analyzed mitochondrial (ND1) and nuclear (ITS1 and ITS2) sequence markers in order to study the dynamics and evolutionary factors acting on biodiversity patterns in natural populations of three African dragonfly species (*Paragomphus genei, Coryphagrion grandis, Trithemis stictica*) These species show different degrees of geographic isolation and habitat specialization and the molecular data show clear correlations between genetic variation and degree of habitat specialization. AMOVA analysis and haplotype definitions show that population structures vary widely from homogenous to the presence of cryptic species.

We acknowledge support from the BMBF (BIOLOG Africa project S08).

Vergleich der Vegetation und Landnutzung der Hügellandschaft von Porto Alegre, Rio Grande do Sul, Brasilien in den Jahren 1966 und 1977/78

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Die Hügellandschaft von Porto Alegre, im Bundesstaat Rio Grande do Sul, in Südbrasilien, besitzt eine hohe Biodiversität, sowohl der subtropischen Regenwälder, als auch der Grasländer. Auf dem Morro do Osso, dem westlichsten Hügel der Kette, befinden sich noch Reste des Küstenregenwaldes Mata Atlântica. Deshalb wird ein offizieller Schutzstatus dieser Hügel angestrebt, um sie vor der drohenden Siedlungsexpansion der Stadt Porto Alegre zu bewahren. Dabei soll die Analyse der historischen Entwicklung der Vegetation und Landnutzung als Schlüssel zum Verständnis der heutigen Situation und somit für die naturschutzfachliche Bewertung der Schutzwürdigkeit dieses Gebietes dienen.

Um die Veränderungen des Gebietes der Hügel zu analysieren, wurden Luftbilder aus den Jahren 1966 und 1977/78 stereoskopisch ausgewertet und im Geoinformationssystem ArcView digitalisiert. Mit Hilfe der anschließenden Flächenverschneidung beider Jahrgänge konnten sowohl die qualitativen, als auch die quantitativen Veränderungen der Vegetations- und Landnutzungstypen und somit die Verluste natürlicher Vegetation von 1966 bis 1977/78 bestimmt werden.

Es lies sich eine Verringerung der Naturflächen feststellen; besonders hoch waren die Abnahmen des Wald- und Buschbestandes. Dagegen zeigte sich eine geringe Zunahme der Grasländer, die v.a. aus ehemaligen landwirtschaftlichen Nutzflächen resultierte. Außerdem konnte aufgezeigt werden, dass die Siedlungsgebiete rasch in das Gebiet der Hügel vorrückten, wobei besonders deren Waldgebiete bedroht sind. In großem Ausmaß gingen Landbewirtschaftungsflächen zugunsten von Siedlungsgebieten verloren oder wurden brachgelegt. Besondere Aufmerksamkeit sollte außerdem den Steinbrüchen gelten, die eine zusätzliche Gefahr der Erosion für die Hügel darstellen.

Biodiversity in African Dragonflies – the genetic consequences of different dispersal dynamics

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Using molecular methods we studied the population structures and dynamics in different African dragonfly species. These species show specific adaptations to the unique ecological conditions of their habitats in Africa. When taking into account the extreme climate, gene flow and genetic diversity within and between populations are important parameters, which influence the ability to react to and survive in a changing environment. We used mitochondrial (ND1) and nuclear (ITS1 and ITS2) sequence markers as well as microsatellite markers in nine species in four genera (*Orthetrum, Paragomphus, Trithemis* and *Pseudagrion*) to investigate whether different dispersal strategies and adaptations to specific habitats are reflected genetically in the population structures. Our molecular data identified genetic substructures within populations as well as isolation and ongoing speciation processes. Since these substructures can not be seen at the organismic level the genetic data are crucial for understanding adaptation processes in African dragonfly species.

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Justicia flava (Acanthaceae) and its flower visitors: Differences in pollination efficiency

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Differences in environmental parameters can lead to changes in diversity and abundance of both plants and animals, and may thus influence the community structure among and even within habitats. As a consequence, interactions between plants and animals and ecological processes like pollination may differ, too. Here we investigate small scale spatial differences in pollinator diversity, pollination efficiency and reproductive outcome of *Justicia flava* (Acanthaceae), an entomophilous perennial herb common to East Africa. The study was performed from May – August 2002 at the Kakamega Forest Nature Reserve, West Kenya, and included three sites: open farmland, forest edge, and forest interior.
At our study sites, *J. flava* is visited by a variety of insects, e.g., some 20 species of bees, with the native honeybee *Apis mellifera* being the most effective pollinator at single flowers. However, as pollinator assemblages differ highly among sites, and as the pollination efficiency of a pollinator species is a function of its abundance, the plants of the three sites even differ in their most effective pollinator.

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„Biodiversity Wave Mechanics": Ziele, konzeptioneller Hintergrund und mathematische Umsetzung

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Die Komplexität lebender Systeme bringt es mit sich, dass ein Verständnis der Biosphäre nur durch unterschiedlichste theoretische Ansätze zu erzielen ist. Auf organismischer Ebene wurde die Möglichkeit der Formulierung physikalischer (energetischer und mechanistischer) Theorien bisher vernachlässigt. In konzeptioneller Analogie zur Wellenmechanik ist eine mathematische (unter Verwendung eindeutig definierter Axiome exakte) Behandlung von Biosphären möglich. Die zeitunabhängige Schrödinger-Gleichung nutzt Axiome zur Natur wechselwirkender Teilchen für eine Definition von Gleichgewichtszuständen, die sich mit einer Erhaltung der Energie des Systems vereinbaren lassen. Die vorliegende Theorie behandelt Organismen als Ausprägungen interagierender Informationslinien unter der Annahme einer Energieflusserhaltung des Systems (Lotkas Prinzip). Dies ermöglicht eine transskalare Berechnung der Variablen, die aus den räumlichen Koordinaten, der metabolischen Rate, der Masse, den Nischencharakteristika und der Position innerhalb des Stammbaums errechnet werden können. Im Fall der konventionellen Wellenmechanik gibt es eine auf analytischem Weg zugängliche reale Situation (das H-Atom, als Zwei-Körper-Problem). Komplexere Systeme können auch über numerische Methoden nur sehr eingeschränkt behandelt werden, da die Rechenzeit mit der Anzahl der Teilchen exponentiell zunimmt. Lebende Systeme sind nicht in sinnvoller Weise analytisch behandelbar, können aber über zelluläre Automaten simuliert werden. Während sich die konventionelle Wellenmechanik auf grundlegende physikalische Konstanten stützen kann, handelt es sich bei den Axiomen, die eine Behandlung lebender Systeme ermöglichen, um messbare Variablen. Eine solche Physik lebender Systeme erlaubt daher keine exakte Voraussage. Als rein evolutionäres Nullmodell dient sie primär der Untersuchung von Kausalitäten und somit auch der Etablierung mathematischer Konstrukte, welche sekundär grobe Voraussagen ermöglichen könnten. Abweichungen der rein evolutionären virtuellen Gleichgewichtszustände von der demographischen Realität können u.a. durch Prozesse oder Phänomene in ökologischen Zeitskalen (z.B. deterministische Oszillationen oder Drift der Dichte) erklärt werden; dabei erhält die Möglichkeit ökologischer Drift eine evolutionäre Grundlage. Während die Identifikation von Kausalitäten in realistisch komplexen Situationen ein "Verständnis" im Sinne eines Lernprozesses erlaubt – als bloße Assoziation zwischen Axiomen und den daraus hervorgehenden Mustern – eröffnen sich drei Wege einer weiterführenden mathematischen Behandlung: (1) Eine phänomenologische Beschreibung von Zusammenhängen ohne tieferes Verständnis (im Sinne der Beschreibung der Arten-Areal-Kurve). (2) Eine qualitative Katalogisierung von Effekten, die sich in Anwendung auf präzise definierte Biosphären mit numerischen Methoden auch errechnen lassen (z.B. hinsichtlich der Entstehung von Endemismuszentren). (3) Die analytische Behandlung einfacher Zusammenhänge in Anwendung auf abstrakte Situationen (z.B. die Erklärung von Damuths Gesetz als Konsequenz von Kleibers Gesetz). Im Sinne mathematischer Beweisführungen hat letzterer Weg in Übertragung auf reale Situationen nur eingeschränkte Aussagekraft und sollte nicht dazu veranlassen, der analytisch-reduktionistischen Behandlung der Physik der unbelebten Natur nachzueifern. Unabhängig davon, ob die Mechanismen nicht früher oder später ansatzweise auch analytisch erfasst werden können, ist das Ziel der hier behandelten Theorie zunächst die numerische Identifikation von Kausalitäten in realitätsnahen Situationen.

Diversity of mycorrhizal fungi and significance for regeneration of an tropical montane cloud forest in Southern Ecuador

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The Ecuadorian tropical cloud forest is composed of many different tree families and species. Microscopical and molecular investigations of the sampled rootlets revealed that members of the Ascomycetes, Basidiomycetes and Glomeromycota are involved as mycorrhizal fungi. All tree species formed mycorrhizas with glomeralean fungi. For *Graffenrieda emarginata* ecto- and arbuscular mycorrhizal structures were found. The roots of *Neea sp.* are ectomycorrhizal. Molecular studies of seven tree species revealed 15 different glomeralean fungi. Using the BLAST procedure 12 sequences could be classed with the genus *Glomus*, two fungi are members of the Gigasporaceae and one belongs to the Acaulosporaceae. In *Graffenrieda* mycorrhizas, for which the highest amount of samples was done, six glomeralean fungi were established, in *Weinmannia* and *Miconia* three species were found. Three species were found to occur at least with two tree species. These species are most likely necessary to raise tree seedlings in nurseries. An identification of the glomeralean fungi was not possible, because no identical sequences are in GenBank. The phylogenetic analyses point towards new species specific for this forest. The results clearly show that the mycorrhizal fungi play an important role in the tropical montane forests.

Die Global Taxonomy Initiative (GTI) in Deutschland

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Die Konvention über Biologische Vielfalt (Convention on Biological Diversity, CBD) wurde 1992 auf dem ersten Weltumweltgipfel in Rio de Janeiro, Brasilien, ins Leben gerufen. In dieser Konvention verpflichten sich die Vertragsstaaten (185 Unterzeichnerstaaten), darunter Deutschland, zum Schutz und zur nachhaltigen Nutzung der global bedrohten Organismenvielfalt.
Auf den Vertragsstaatenkonferenzen (Conference of the Parties, COP) werden verbindliche Erklärungen und Beschlüsse gefasst, mit denen konkrete Programme der CBD initiiert werden. Zur Verbesserung der weltweit dringend benötigten, biosystematisch-taxonomischen Kompetenz wurde auf der 6. Vertragsstaatenkonferenz im April 2002 die "Global Taxonomy Initiative" als offizielle Maßnahme der CBD mit einem ausführlichen, 18-Punkte-Arbeitsprogramm verabschiedet. Das wichtigste Ziel der GTI besteht in der Stärkung und Vermehrung taxonomischer Kenntnisse und Kapazitäten weltweit, soweit diese für die Ziele der CBD benötigt werden. Diese Bemühungen werden international über die GTI koordiniert, mit besonderer Bedarf in den Tropen und biodiversitätsreichen Entwicklungsländern. Im GTI-Arbeitsprogramm werden die Vertragsstaaten u.a. verpflichtet, je eine Nationale Kontaktstelle (GTI - National Focal Point, NFP) einzurichten, und über die aktuell verfügbaren Ressourcen auf dem Gebiet der Systematik und Taxonomie zu berichten. Darin enthalten ist eine Bedarfsanalyse, um Prioritäten für ein nationales "capacity building" festzulegen. Deren Ergebnisse werden bei zukünftiger Förderung taxonomischer Kapazitäten von Bedeutung sein. Die GTI stellt somit auch ein Instrument zur gezielten Förderung biosystematischer Forschung dar, unterliegt jedoch dem politischen Mandat der CBD.
Das Staatliche Museum für Naturkunde in Stuttgart hat seit August 2002 im Auftrag des Bundesamtes für Naturschutz (BfN) bzw. des Bundesumweltministeriums (BMU) den Aufbau des GTI-NFPs übernommen und wird die Durchführung des GTI-Arbeitsprogrammes koordinieren. Die Kontaktstelle soll weiterhin als Anlaufstelle für nationale und internationale Aktivitäten im Rahmen der GTI dienen und bei der Vermittlung relevanter Kontakte behilflich sein.
Der Erfolg dieser für die Umsetzung der CBD wichtigen Initiative wird wesentlich von der aktiven Beteiligung und Mitwirkung der Fachwissenschaft bestimmt werden. Vor diesem Hintergrund strebt die Nationale Kontaktstelle der GTI eine möglichst enge Kooperation mit relevanten Forschungseinrichtungen und Fachverbänden, wie besonders der Gesellschaft für Tropenökologie an, um Fragen der Prioritätensetzung für nationale GTI-Aktivitäten und mögliche Strategien für eine effiziente Umsetzung des GTI-Arbeitsprogramms diskutieren und formulieren zu können.
Offizielle Dokumente zur CBD wie GTI finden Sie unter: siehe www.biodiv.org

The Global Species Register Butterflies GART (Globales Artregister Tagfalter)

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The long-term aim of the GART project is to create a globally comprehensive, digital information system for butterflies (Papilionoidea) based on a taxonomic and bibliographic database. The GART taxonomic database is expected to contain bibliographic and taxonomic information for all described butterfly taxa and will provide in itself a sound working basis for future biosystematic and biodiversity research on butterflies worldwide. Short term goals of GART include the digitised documentation of all butterfly primary type specimens housed in German museum collections. Up-to-date global species inventories will be developed for two families of butterflies, Swallowtails (Papilionidae) and Whites (Pieridae). For selected taxa within these two families (Papilionidae: *Battus*, *Zerynthia*; Pieridae: *Anthocharis*, *Colotis*, *Gonepteryx*), a comprehensive species information system will be developed offering primary data about distribution, ecology, and morphology of individual species as well as links to other existing data sources. All the databased information from the GART project will be made available through a central user interface on the internet via the SYSTAX information system in cooperation with the University of Ulm [www.biologie.uni-ulm.de/systax/].
The GART project is co-ordinated by the State Museum of Natural History Stuttgart (SMNS) and implemented in co-operation with the following institutions: Deutsches Entomologisches Institut, Eberswalde; Forschungsinstitut und Naturmuseum Senckenberg, Frankfurt/Main; Museum für Naturkunde der Humboldt Universität, Berlin; Staatliches Museum für Naturkunde, Karlsruhe; Staatliches Museum für Tierkunde, Dresden; Zoologisches Forschungsinstitut und Museum Alexander Koenig, Bonn; Zoologische Staatssammlung, München. GART forms part of the EDIS (Entomological Data Information System) project scheme [www.insects-online.de] also co-ordinated by SMNS, which is being supported by the German Federal Ministry for Education and Research (Bundesministerium für Bildung und Forschung, BMBF) within its Biodiversity Informatics component of the BIOLOG funding programme [www.dlr.de/PT/Umwelt/F70000/F73000/BIOLOG-allgemein.htm].

The GART work plan and its current implementation:
a) Development of comprehensive taxonomic and bibliographic databases for the families Papilionidae and Pieridae (ca. 18.000 taxa); currently, the database contains 2.800 taxa, the literature database 24.000 records.
b) Establishment of global, synonymic species registers for the families Papilionidae and Pieridae; currently, the inventory list of valid Papilionidae species is already complete (552 species), the Pieridae version exists in a first draft (1.064 species) [see: www.insects-online.de/frames/papilio.htm].
c) Identification, photographic documentation, and database recording of butterfly primary type specimens housed in German collections; currently, more than 3.000 type specimens have been documented in the museum collections of Berlin, Bonn, Dresden, Eberswalde, Frankfurt, Karlsruhe, Munich, and Stuttgart.
d) Development of a comprehensive, pilot species information system on butterflies, for selected groups of Papilionidae and Pieridae; currently, a test version for the papilionid genus *Battus* is under development [for early results, see: www.s2you.com/edis/ index.php].
e) Survey and interlinking of additionally available, web-based information on butterflies, especially of Papilionidae and Pieridae; currently, a structured link list is available on the web [www.insects-online.de/linkfram.htm].

Spatial distribution patterns of the tree Anogeissus leiocarpus along borders of forest islands in the Comoé National Park (NE Côte d'Ivoire)

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A major spatial consequence of habitat fragmentation is an increase in peripheral zones with edge effects most strongly influencing small fragments. In the context of nature conservation a detailed knowledge of the vegetation dynamics in peripheral zones of undisturbed regions is necessary for the development of sustainable management practices in areas underlying human impacts.

In the Comoé National Park (CNP), edge effects (e.g. composition of vegetation, microclimate and fire), and dynamics of forest margins are being studied in detail in order to gain insight into the processes relevant for the previous and upcoming development of forest fragments. For this purpose eight transects perpendicularly crossing the forest borders from the closed dry forest into the open savanna have been established. At the forest border, the vegetation changes abruptly from tree dominance to grass dominance.

A particular focus is laid on spatial patterns of the tree species *Anogeissus leiocarpus*. This "somewhat fire-resistant" Combretaceae shows characteristics of a pioneer species and frequently forms a belt around forest islands in the CNP. Two aspects have been considered in particular:

1. How are the different size classes of *A. leiocarpus* distributed along the ecological gradient between forest and savanna in comparison to the distribution of other tree species?
2. Which ecological factors support the establishment of *A. leiocarpus* along the forest/savanna-gradient?

Tree individuals were mapped along the transects and grouped into four size classes (SC1: 0-1cm DBH, SC2: 1-6cm DBH, SC3: 6-30cm DBH, SC4: >30cm DBH). Tree data were pooled for five vegetation zones along the transects of 260m length: savanna (0-30m), savanna/forest edge (85-115m), forest edge (115-145m), forest edge/forest interior (145-175m) and forest interior (230-260). In the sampling plots of the two younger life stages general site parameters such as vegetation cover, grass biomass and soil depth were measured.

The results show that the size classes SC2 and SC3 of *A. leiocarpus* occur with highest density in the "forest edge" zone. The largest size class (SC4) shows highest abundance in the "forest edge/forest interior" zone, whereas the smallest size class has a maximum density in the zone "savanna/forest edge". For the occurrence of a high abundance of size classes SC1 and SC2 fire appearance and shading effects by larger trees seem to be most influential.

The hitherto obtained results indicate that *A. leiocarpus* slowly advances from the forest edge to the savanna what could lead to an extension of forest islands. This process is counteracted, however, by savanna fires causing high mortality among *A. leiocarpus* offspring what could results in an equilibrium between forest and savanna. For a better understanding of the spatial and temporal dynamics within the vegetation mosaic in the CNP under different scenarios of global change long-term monitoring data will be used for a modelling approach.

This study is embedded in the program BIOTA (Biodiversity Monitoring Transect Analysis in Africa), funded by the German Federal Ministry of Education and Research (BMBF).

Als El Niño noch normal war... Folgen neuer Klimaschwankungen auf die Fisch- und Avifauna in der Lagune Ciénaga Grande de Santa Marta, Kolumbien

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Die Küstenlagune Ciénaga Grande de Santa Marta wird durch das Mündungsdelta des Río Magdalena gebildet und war eine der bedeutendsten Fischereiregionen in Kolumbien. Nach Strassenbaumaßnahmen Ende der 60er Jahre veränderte sich das Wasserregime gravierend. Durch hohe Verdunstungsraten stieg die Saliniät massiv an, was flächenhaftes Mangrovensterben zur Folge hatte. Anfang der 90er Jahre begann die Gesellschaft für Technische Zusammenarbeit mit dem Bau großer Kanäle, die Süßwasser aus dem Rio Magdalena in die vielen Lagunenkompartimente, genannt Ciénagas leiten sollten.
Trotz erfolgreichem Bauabschluss der Kanäle Ende der 90er Jahre erreicht das Ökosystem nach wie vor keinen stabilen Status. Im Gegensatz zur Vegetation reagieren Fischfauna und in Folge die fischfressende Avifauna sehr schnell auf Schwankungen im Wasserhaushalt. So werden nach wie vor mehrfach pro Jahr Fischsterben beobachtet. In den Jahren 2001 und 2002 sind die Brutpopulation von vielen Tausend Paaren Reihern und Kormoranen auf Null zusammengebrochen.
Die Klimadaten von 1960 bis Anfang der 1980er Jahre weisen 3-5jährige Zyklen mit wiederkehrender Trockenheit auf, die auf regelmäßige El Niño Phänome zurückzuführen sind. Seit etwa 1982 brechen die Niederschläge zu Extremwerten aus, besonders trockene Jahre wechseln sich mit extrem niederschlagsreichen Jahren ab. Dementsprechend reagieren die abiotischen Wasserparameter auf diese starken Fluktuationen. Die Fischfauna konnte zuerst den Ausschläge der Salinitäten folgen. Nach starkem Absinken des Salzgehaltes dominierten die künstlich eingebrachten *Cichliden* die Fischfauna, in den trockenen Jahren verblieben im Wesentlichen die lagunentypischen Kreuzwelse (z. B. *Cathorps spixii, Arius bonillai*). Die fischfressende Avifauna, dominiert von Kormoranen (*Phalacrocorax b. brasilianus*) und einigen Reiherarten (*Ardea alba, Egretta thula, Egretta tricolor*) wird in in der Ciénaga Grande in ihrer Reproduktion durch diejenige der Fischfauna getriggert. Der Bruterfolg hängt extrem von dem Vorhandensein von Jungfischen ab. Die Vogelarten gingen unterschiedlich mit diesem Phänomen um. Die kleinen Reiherarten (*Egretta spec.*) setzten teilweise mit der Reproduktion vollständig aus, während die großen Reiherarten (*Ardea spec.*) und Kormorane nur begrenzt flexibel reagieren konnten. Massensterben von Reiher- und Kormoranküken in den Jahren 1997 und 2000 waren die Folge. In den letzten beiden Jahren wurden die Massenkolonien von allen Arten aufgegeben. Ein Phänomen, das selbst zu Zeiten des massiven Mangrovensterbens Anfang der 1980er Jahre nicht bekannt war. Das im Oktober 1998 deklarierte RASMAR-Schutzgebiet ist zumindest momentan als Brutgebiet für die ehemaligen „Keystone"-Arten wertlos.

Amphibian assemblages in primary, secondary and fragmented forests in western Ivory Coast

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We studied the influence of forest fragmentation and logging activities on leaf litter amphibian assemblages in the Taï region, western Ivory Coast. Studies were carried out in primary, secondary and fragmented forests. In Taï National Park (TNP) 10 sites were chosen, six in primary, three in secondary forest. Additionally, we investigated 14 fragmented forests outside TNP. These fragments varied by surface, distance to TNP, fragmentation date, vegetation structure, presence or absence of lentic and lotic breeding sites, and level of human disturbances. For data acquisition, a combination of visual encounter surveys and acoustic sampling were performed on 2-ha plots.

A total of 21 species of leaf litter frogs, belonging to five families, were recorded. Diversity, assemblage composition and species abundance varied between primary forest and secondary forest within TNP, as well as between TNP communities and those of forest fragments. Generally, the observed diversity was highest in primary forests, followed by secondary forests and the forest fragments.

Analyses of the different leaf litter assemblages detected different factors responsible for anuran diversity. Besides true primary forest species, we recorded several species present in almost every type of forest, reaching even higher abundance in secondary or fragmented sites. Habitat parameters like vegetation structure and varying breeding sites were the most important factors predicting assemblage composition. While geographic distance might be influential as well, size of forest fragments seemed to be of less importance for species presence in particular and diversity in general, at least when comparing forest fragments only.

Changing tropical diversity of marine systems in Panama

Höbart, G.

Marine and coastal biodiversity is one of the programmes of the Convention on Biological Diversity (CBD). Corals are endangered world-wide, estimations end of 2000 were that approximately 27% of coral-reefs are destroyed already. This poster demonstrates the situation of the coral reefs at the archipelago of Bocas del Toro in the tropical climate of the Caribbean coast of northwest Panama. In April 2000 three different research spots of healthy and dying patch reefs were examined closely in their richness of species and grade of destruction by sedimentation and the growth of seaweed. The reefs showed the signs of severe degradation.
The factors endangering the coral reefs are extensive banana plantations wide-spread in the region being the cause for loads of sediments and pesticides which are washed down the rivers into the sea and damage the corals in their biological processes. After harvesting the banana industry is shipping the fruits for the export overseas conserving them with chemicals. Contamination by oil originating from the ships and also by diesel from the numerous small boats being the only mean of transport between the islands and the mainland endanger the sea water. With the beginning of tourism since about 1997 an uncontrolled infrastructure development began. Construction activities and deforestation on the islands lead to additional sedimentation deteriorating the light conditions. Poison from inadequately detoxified waste and nutrient entries with the waste water disturb the ecological balance of the sea. The consequences of a heavy earthquake in 1991 accelerate the already worsening situation of the patch reefs due to geomorphological changes on the mainland resulting in further sediment loads. Warming of the sea temperature during El Niño events in the last decade lead to coral bleaching and illnesses caused by bacteria.
The results indicate the strong need to develop a management plan for the region. A sustainable management strategy has to comprise physical measurements against soil erosion, e.g. agroforestry as an alternative land-use form, and anthropogenetic solutions like the development of ecological tourism in combination with a consequent environment policy. Only by conserving the marine resources the local population has a long-term economic and social basis to live on. More detailed information can be obtained from the author (gabyhobart@aol.com).

Diversität und Funktion der Bodenbiota in Küstenregenwäldern Südbrasiliens

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Ziel des vorgestellten Projekts in seiner ersten Phase von 2002 - 2004 ist die Erarbeitung von Grundlagen für eine Beurteilung der Wirkung anthropogener Veränderungen des Habitats auf die Artenvielfalt und -verteilung der Bodenbiota in zwei Waldtypen der südlichen Mata Atlântica, die auf unterschiedlichen Böden wachsen (Restinga-Wald auf Sandboden, Serra-do-Mar-Wald auf Lehmboden). Das Projekt ermittelt zugleich die funktionelle Bedeutung der Bodenbiota für Streuabbau und Nährstoffkreisläufe unterschiedlich alter Regenerationsphasen dieser Wälder. Anhand der Ergebnisse wird die Bedeutung von Sekundärwäldern für die Konservierung und Regeneration der Artenvielfalt der Mata Atlântica beurteilt.
Im Zentrum der funktionellen Untersuchung steht ein Streubeutelexperiment zur Differenzierung der Leistung der Makrofauna, Mesofauna und der Mikroorganismen im Streuabbau in fünf Flächen. In Verbindung damit werden die Hauptakteure des Streuabbaus sowie wichtige Indikatorengruppen unter den Bodenarthropoden, d.h. Ameisen, Tausendfüßer, Asseln, Schaben, Spinnen, Käfer, Termiten sowie Regenwürmer und Enchyträen in ihrer Abundanz, Biomasse und Diversität erfasst. Mikrobiologische Aktivität, unterschieden nach bakteriellem und pilzlichem Anteil wird an Boden- und Streuproben anhand der CO_2-Produktion im IRGA gemessen. C/N-Analysen der für den Streuabbau relevanten Substrate dienen der Beurteilung der Effekte der Bodenbiota auf die Nährstoff-Pools in den verschiedenen Regenerationsstadien.
Die Diversität der streu- und bodenbewohnenden Makrofauna und der Mikroflora wird in insgesamt 18 Flächen untersucht. Ausgewählte Arthropoden-Taxa werden dazu mit standardisiertem Sammelprotokoll, die Regenwurm- und Enchyträenfauna durch Formol- sowie Nassextraktion erfasst. Die Diversität der Mikroorganismen wird über die metabolische Fingerprints auf Platten mit den wichtigsten Kohlenstoffquellen erfasst. In allen besammelten Flächen werden einmalig die wichtigsten Ökosystemparameter (Boden, Streu, Streuabbaurate, Vegetation, Mikroklima) aufgenommen.

Die Untersuchungen werden finanziert vom Bundesministerium für Bildung und Forschung (BMBF) und dem Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) im Rahmen des Deutsch-Brasilianischen Kooperationsprogramms Ciência e Tecnologia para a Mata Atlântica" - Project number 01LB0201

Lepidopterendiversität und Vegetationsstrukturen im Vergleich kleinbäuerlicher Wirtschaftssysteme und Großfarmen

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Die vorliegenden Untersuchungen wurden im Rahmen des von der DFG geförderten Projektes „Regeneration tropischer Bergregenwäder am Beispiel des Kilimanjaro" durchgeführt.

In einem Höhentransekt zwischen 1200 und 1650 m wurden auf 7 Flächen das Vorkommen von Nachtfaltern (Geometridae) sowie die Physiognomie der Vegetation untersucht. Vier der Flächen lagen auf Großfarmen, drei weitere im kleinbäuerlichen Agroforstbereich.

Die Analysen zeigen deutlich, dass sich intensiv genutzte Kaffeefelder und traditioneller Kaffeeanbau auf kleinräumigen Agroforstflächen anhand von strukturellen Merkmalen der Vegetation klar trennen lassen. Wichtige Vegetationsmerkmale zur Klassifikation und Beschreibung des Kulturlandes sind zum einen Bestandesparameter wie die Anzahl der Schichten und zum anderen Individuenmerkmale wie Kronendurchmesser und Kronendichte. Zur Unterscheidung der Anbausysteme waren Merkmale wie Reihenpflanzungen und Größe der Blätter in der unteren Baumschicht entscheidend.

Die Untersuchung der Mottendiversität mit Hurlbert-Rarefaction-Kurven ergab, dass sich die Bewirtschaftungssystemen ebenfalls klar unterscheiden. Auf den kleinbäuerlichen Systemen lagen höhere Werte der Alpha-Diversität vor. Dabei ist zu beachten, dass die Großfarmen auf deutlich niedrigerer Höhe von 1200 bis 1400 m lagen als die kleinbäuerlichen Agroforstflächen (1600 m). Bei Insekten wäre dabei eher damit zu rechnen, dass die Diversität mit der Höhe abnimmt, was auch auf parallel untersuchten Waldstandorten des Kilimanjaro zu beobachten war.

Daraus lässt sich folgern, dass mit steigender Komplexizität der Vegetationsstruktur auf landwirtschaftlich genutzten Flächen am Kilimanjaro auch die Diversität der Geometriden zunimmt.

Visual Plants – a data capturing tool for plant diversity information

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Topic: Biodiversity, data capturing

Visual Plants is a program which is intended to be used in the field without any internet connection. This tool allows the capturing of information about plants together with the presentation of plant images. This allows a rapid classification to which family, genus or species an unknown plant belongs and helps through a determination tool the visual determination of plants. All necessary information about the plants can be stored in the database which allows a rapid search for all relevant information.
An easy manageable user interface allows also students with small computer experience to work with the tool. Sources for the plant images are digitized slides, flatbed scans of fresh plant material, digital photographs of plants from the field and digital photographs from herbarium specimen. This provides all relevant information (depending on the quality of the images) to determine a species.

Baumartendiversität und Waldstruktur im costaricanischen Bergregenwald

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Im Rahmen des DFG-Projektes „Waldlücken- und Wuchsdynamik der Baumarten tropischer Bergregenwälder in Süd-Ecuador und Costa Rica" wird unter anderem die Baumartenzusammensetzung in verschiedenen Höhenstufen untersucht. Im September 1999 wurde mit den Untersuchungen im Gebiet der RBAMB (Reserva Biologica Alberto Ml Brenes, 10° 13'N, 84° 36'W) in Costa Rica begonnen. Das Schutzgebiet besteht aus prämontanem tropischen Regenwald in zwischen 800 und 1500 m

Auf 13 verschiedenen 400m²-Parzellen wurden alle Bäume mit einem Brusthöhendurchmesser (BHD) ab 5 cm mit ihrer Position, Höhe und BHD aufgenommen. Zur Identifikation wurden von allen Arten Belege gesammelt. Die Untersuchungsplots sind auf drei Standorttypen mit unterschiedlicher Exposition verteilt (Flußtal, Kammlage, Hanglage) und liegen zwischen 840 mNN und 1180 mNN. Ähnliche Untersuchungen aus Ecuador werden interessante Vergleiche ermöglichen.

Die Baumartendiversität im Gebiet ist sehr hoch: Auf der insgesamt 0,52 ha großen Fläche wurden bisher 146 Baumarten aus 55 Pflanzenfamilien identifiziert.

Die artenreichsten Baumfamilien (BHD=5cm) in den Dauerparzellen sind Rubiaceae (14 Arten), Lauraceae (11), Melastomataceae (10), Mimosaceae (9) und Moraceae (9). Die am häufigsten auftretenden Arten sind die beiden Palmen *Cryosophila warscewiczii* und *Iriartea deltoidea*, sowie die Rubiaceae *Elaeagia auriculata.*

Mit Hilfe des NESS (Normalised Expected Species Shared) -Index wurden die Plots auf Ähnlichkeiten in der Artenzusammensetzung untersucht.

Eine multidimensionale Skalierung auf Grundlage des NESS-Index ergibt eine Auftrennung der Untersuchungsflächen in Gruppen, wobei die erste Dimension als eine Kombination der Faktoren Meereshöhe und Exposition interpretiert werden kann. Die drei verschiedenen Standorte (Flußtal, Kammlage, Hanglage) sind aufgrund ihrer Artenzusammensetzung statistisch unterscheidbar.

Die Stammkreisflächen liegen zwischen 0,8 und 1,9 m² pro Plot bei 35 bis 70 Stämmen über 5 cm Durchmesser, dabei scheinen sich die drei Standorttypen nicht zu unterscheiden.

Einige Familien kommen im Gebiet bevorzugt in Kammlage vor wie zum Beispiel Araliaceae, Cunoniaceae, Myrsinaceae und Rosaceae, andere dagegen wie Acanthaceae, Euphorbiaceae und Meliaceae sind hauptsächlich im Flußtal zu finden.

Transpiration before and after Burning in Different "Cerrado" Vegetation Types of the Brazilian Savanna

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The savanna vegetation in Brazil, also known as Cerrado, has been estimated to cover 1.8 mil km^2. This large ecosystem is dominated by fire and composed by a successional series that varies in species composition and tree density. In this study, the effects of fire on the rates of xylem flux density will be compared by measuring the flow of xylem water in trees before and after fire occurrence at two Cerrado vegetation types: campo sujo (tree and/or shrub savanna) and Cerrado (wooded savanna). The study is being conducted at the Reserve of the Brazilian Institute for Geography and Statistics located 34 km south of the city of Brasilia. Nine trees of the most common tree species are being monitored at each site. Xylem flux density and stem temperature sensors were installed at all sites during mid April. One Campo sujo site and one Cerrado site were burned during mid June 2002, following a bi-annual plan for prescribed fires managed by the University of Brasilia. Xylem sensors were removed just before the fire and reinstalled after the fire in the two areas burned, while measurements continued uninterrupted in two controlled areas.

At the moment, the first results from the early dried season before fire are being processed and these will be compared to the data to be collected in late June for the post-fire period. It is expected that fire will reduce considerably the values of xylem flux density. The data from this study will help to determine the degree of adaptation of Cerrado tree species to fire, measured by the level and speed of recovery of the xylem flux rates after the fire.

Changes of a fish community in an ephemeral savanna stream during the rainy saison - Comoé Nationalpark, Ivory Coast, West Africa

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With the progressing rainy saison, intermittent streams in the drier savanna areas start flowing again, the flow of major rivers greatly increases, lake levels rise and ephemeral ponds are created. These newly created aquatic habitats are used by different fish species as feeding, spawning and/or nursing ground.

The aim of the study was to investigate a fish community of an ephemeral savanna stream from mid-June until September 2002 (from intermediate dry season to the end of the rainy season). The investigated stream formed by two tributaries is connected to ephemeral savanna ponds temporarily. The two tributaries differ concerning their morphology, conductivity and turbidity.

The fishes were caught by electrofishing every two weeks and in accessible areas during the rainy season basket traps were used. Abiotic factors (conductivity, temperature, pH, oxygen concentration) were measured twice a week.

4940 representatives of 37 species (11 families) were collected. During the research period changes in the abundance of some fish species were recorded. By means of the multivariate correspondence analysis is intuited how the fish community is structured by selected biotic and abiotic parameters.

Entdeckung von Ameisengärten in der Paläotropis: Vielfalt und Bedeutung in südostasiatischen Tieflandregenwäldern

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Eine der wichtigsten mutualistischen Beziehungen zwischen Ameisen und epiphytischen Gefäßpflanzen stellen die sogenannten „Ameisengärten" dar: Ameisen sammeln gezielt die Samen bestimmter Epiphyten und tragen sie in ihre Kartonnester ein. Die Samen keimen in den Nestern und wachsen in nährstoffreichem Substrat heran. Die Wurzeln der Epiphyten dienen den Ameisen zur Stabilisierung und Strukturierung des brüchigen Kartonmaterials.
In der Neotropis sind Ameisengärten ein seit langem bekanntes Phänomen, in der Paläotropis blieb ihre Existenz hingegen bislang weitgehend unerkannt. In den letzten Jahren ergaben unsere Untersuchungen in Malaysia (Halbinsel und Borneo), Thailand und Java jedoch, dass die Vielfalt von an Ameisengärten beteiligten Ameisen- und Epiphytenarten in Südostasien ebenso hoch ist wie in der Neotropis. Insgesamt konnten 18 Ameisenarten aus fünf Gattungen und vier Unterfamilien als „echte" Ameisengarten-Ameisen identifiziert werden, d.h. sie trugen gezielt Samen bestimmter Epiphytenarten in ihre Kartonnester ein. Auf Epiphytenseite wurden 51 Arten (19 Gattungen, 12 Familien) als „echte" Ameisengarten-Epiphyten eingestuft, d.h. ihre Samen waren für bestimmte arboricole Ameisen attraktiv und wurden von diesen in ihren Nestern „angepflanzt".
Ökologische Vergleiche zwischen verschiedenen Ameisengarten-Systeme ergaben, dass sich zwar die jeweiligen prinzipiellen Nutzeffekte für die beteiligten Ameisen und Pflanzen ähnelten, doch bestanden insgesamt bedeutende Unterschiede. Als Nutzeffekt für die Epiphyten ist insbesondere eine gezielte Samenausbreitung in ein nährstoffreiches Substrat mit relativ hoher Wasserspeicherkapazität zu nennen; die Ameisen profitieren vor allem durch die Erweiterung ihres Nistraumspektrums. Die wichtigsten Unterschiede zwischen den verschiedenen Ameisengartensystemen, die jeweils von Seiten der Ameisen klassifiziert wurden, sind: unterschiedliche Spezialisierungsgrade auf einzelne Epiphytenarten; unterschiedliche Spezialisierungsgrade auf bestimmte Wirtsbäume; Unterschiede in der Nutzung und Pflege von Trophobionten; Unterschiede in der Abhängigkeit von vorgeformten Höhlungen als Nistraum; Anzahl der weiteren an der Assoziation beteiligten Partnerorganismen; Schlüsselreize, die das Samentragen auslösen.
Ein Abgleich der gefundenen Ameisengarten-Epiphyten mit den auf der Malaysischen Halbinsel vorkommenden Epiphytenarten (mit Ausnahme von Farnen, Orchideen und fakultativen Epiphyten) ergab, dass ein großer Anteil der epiphytischen Gefäßpflanzen der Tieflandregenwälder wenigstens in der Phase der Ansiedlung völlig auf Ameisen angewiesen ist. 52 % der Epiphytenarten aus allen in Frage kommenden Gattungen sind nach unseren Ergebnissen Ameisengarten-Epiphyten; die übrigen Arten wurden während unseren Untersuchungen nicht gefunden, weshalb sich der prozentuale Anteil noch deutlich erhöhen kann.
Diese Zahlen belegen bereits die große Bedeutung von Ameisengarten-Ameisen für die Ansiedlung von Epiphyten im Kronenraum südostasiatischer Tieflandregenwälder. Dieses Ergebnis wird durch eine große Zahl von opportunistischen Ameisen- und Epiphytenarten unterstützt, die sich sekundär in bereits bestehenden Ameisengärten ansiedelten. Ameisengärten haben somit einen gewissen „Pionier-Charakter" für die Besiedlung von Baumkronen. Dies gilt nicht nur für Ameisen und Epiphyten, sondern auch für eine Fülle anderer Organismen, die als „Gäste" in den Ameisengärten leben.

Species richness and foraging behaviour of trap-nesting bees and wasps in agroforestry

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Traditional agroforestry systems are known to be rich in biodiversity, and can be expected to support ecological services such as predation and pollination. Different management practises in agroforestry and regional landscape context may influence ecological services. Trap-nesting bees, wasps, and their natural enemies are promising indicators for such ecological changes. Here, we tested weather the number of species and individuals of trap-nesting bees, wasps, and their natural enemies, and the foraging time of pollen-collecting bees and caterpillar- or spider-hunting wasps change in differently managed agroforestry systems.
In Central Sulawesi (Indonesia) in the Napu Valley at the south-eastern margin of the Lore-Lindu National Park a total of 240 trap nests (ten per study site) have been placed between January 2001 and March 2002 in 24 agroforestry systems. We focused on six different agroforestry systems each with four replicates, which differed in shade level, vegetation, and forest distance. Each trap consisted of about 120 internodes of a mixture of common reed *Phragmites australis* (Cav.) Trin., and Japanese knotweed *Reynoutria japonica* Houtt, with a length of 20 cm, put into plastic tubes. We measured the foraging time of one bee species (*Heriades* (*Michenerella*) sp. aff. *fulvescens*, Apidae), and two wasp species (the spider-hunting *Auplopus lecivarinatus*, Pompiliidae, and the caterpillar-hunting *Rhynchium haemorrhoidale umeroatrum*, Eumenidae). With a stopwatch the time between arrival and departure of each of the three species was measured at least 10 times per study site. Altogether, we found 14 trap-nesting species with 13,673 individuals and 23 enemy species with 910 individuals. The community structure and the foraging time of trap-nesting bees and wasps changed with the management of agroforestry systems. The fastest mean foraging time of the pollen-collecting bee and the caterpillar-hunting wasp was observed in the slightly shaded systems, but not for the spider-hunting wasp. These results show that the community structure and foraging behaviour of trap-nesting hymenoptera is related to habitat quality of agroforestry systems.

Coral reef colonisation: How optimal temporal and spatial settlement decisions of larvae shape invertebrate communities

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Settlent is a keystone process

Where and when to settle are crucial decisions for invertebrate larvae within coral reef communities. Once settled the larvae are immobile, so their choice of location determines their survival and lifetime reproductive success. Within days or even hours after fertilization decisions on how to optimize an individuals fitness have to be made. This represents a keystone process in the dynamics of reefs, contributing to a biotic framework for higher organismic levels. Our understanding of the mechanisms generating and maintaining community structure on reefs needs to be substantually improved to meet management requirements in present times of global change (Wenzlaff, 2002).

Hypothesis – larvae know where to settle

We studied settlement behaviour of larvae of three model organisms, *Herdmania curvata* (*Chordata*, Ascidian), *Filograna implexa* (*Annelidae*, Polychaete) and *Reneira* sp. (*Porifera*, Demosponge), on Heron Island, Great Barrier Reef, Australia. It was hypothesized that larvae reach settlement optimality by (a) timing settlement competence, (b) measuring environmental light levels and wave lengths and (c) the ability to distinguish between substrates. Individuals were collected in the field, transferred into controlled laboratory conditions at Heron Island Research Station and spawning / fertilization of eggs was induced. Larvae were then offered a variety of natural substrates and surfaces and were exposed to different light regimes. Timing of settlement and influence of other organisms were measured.

Results

Herdmania readily settled, without distinction, on provided substrates as soon as competence was achieved. In contrast, the more slowly developing *Filograna*, showed clear preferences regarding substrate. Sponge larvae were confirmed to be able to measure light conditions and thus actively search for ideal environmental conditions to settle, and Annelids possessed similar abilities, but were even better at finding optimal substrates: Fresh coral skeletons in shaded, protective situations were favoured. To guarantee dispersal, competence in Annelids was shown to be reached later than in Ascidians, which are consequently temporally restricted in their choice. Annelid larvae are immobile – the optimal evolutionary strategy in this case of short-distance passive dispersal is settlement on any available substrate for highest chances of survival. Finally, additional mesocosm experiments proved that some sponge and algae species are capable of inhibiting ascidians from settling – it is most likely that biotoxins excreted prevent competitors from settling, thus creating density-regulated patterns on reefs.

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High variability in diversity and abundance of vascular epiphytes within Amazonia

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This study provides the first direct comparison of the epiphytic vegetation of two Amazonian lowland rain forests, situated more than 1000 km apart from each other. At Western Amazonian Tiputini Biodiversity Station, Ecuador (220 m a.s.l.; 0°38'S, 76°9'W), we carried out a complete survey of all individual plants of vascular epiphytes in a 0.1 ha plot. Regarding the systematic composition, diversity, and abundance of vascular epiphytes, the results are compared to those of an equivalent survey of the 1.5 ha plot at Northern Amazonian Surumoni Crane Project, Venezuela (100 m a.s.l.; 3°10'N, 65°40'W). Additionally, structural parameters of host trees as well as the occurrence of epiphytic mosses and lichens, canopy soil, and ant gardens on epiphyte growing sites are analyzed. Centers of altitudinal distribution of all species are determined using collecting locality data of > 30,000 herbarium specimens. At Tiputini, 8762 epiphytic individuals of 146 species and 24 families are found on 0.1 ha, facing only 1760 individuals of 80 species and 14 families on 1.5 ha at Surumoni. Calculated for quadrants of 25 m², an average of 241.8 individuals and 20.6 species is found in Tiputini, whereas the average in Surumoni is 2.9 individuals and 1.2 species. Comparing individual and species numbers with various other neotropical 0.1 ha plots reveals an extraordinarily high alpha-diversity and abundance of epiphytes at Tiputini. Araceae with 49 species (33.6 %) is the most diverse family at Tiputini, whereas ferns with 7357 individuals (77.3 %) represent by far the most abundant taxonomic group. At Surumoni, Orchidaceae with 33 species (41.3 %) are most diverse, and Araceae with 949 individuals (53.9 %) are most abundant, represented predominantly by ant garden species and secondary hemiepiphytes, which begin their life cycle with contact to the ground. The vast majority of epiphytic individuals at Tiputini is found on old, structurally diverse upper canopy trees with large dbh, whereas most of the individuals in the late successional forest of Surumoni grow on smaller trees. Most individuals in Tiputini grow on humus accumulations or epiphytic mosses. At Surumoni, humus accumulations are virtually absent and pure bark is the most common epiphyte substrate, followed by ant gardens. Adaptations to the scarcity of nutrients predominate in Tiputini among both epiphytic individuals and species, while adaptations to water deficiencies are more important in Surumoni. We consider the uneven distribution of precipitation throughout the year to be the major reason for the low epiphyte diversity and abundance at Surumoni. On the other hand, the high and evenly distributed annual precipitation at Tiputini and the proximity to the Andes cause the higher number of species with a predominantly montane distribution and thus exceptionally high epiphyte diversity in the lowlands. Besides, the influence of paleoclimate, soil fertility, topography, and forest structure is discussed.

Human impact on forest fragmentation in the Comoé National Park region, NE Côte d'Ivoire

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Generally speaking, the present increase in habitat fragmentation and the concomitant loss of biodiversity are mainly caused by human activities. In Côte d'Ivoire, habitat fragmentation is accelerated by intensified forest exploitation, agriculture, and traffic infrastructure because of demographic growth and climate changes in the course of global change.
The North of Côte d'Ivoire is characterized by a natural vegetation mosaic including savannas and little degraded as well as degraded island forests. This vegetation cover is representative for the entire transition zone between the Sudanian and Guinean zone of West Africa as well as for many other tropical regions of the world. Yet, the vegetation of northern Côte d'Ivoire has been subjected to merely a few botanical studies. In consideration of the present increase in land utilization, detailed insights into the mechanisms and consequences of anthropogenic forest fragmentation must be accomplished. This is to be achieved by a new study where the former and the present utilization regime and ethnobotanical aspects are taken into account. The results obtained in a utilized region neighbouring the Comoé National Park will be compared with the results in the Park.

The specific objectives are
- to identify the occupation modes and land use systems by ethnobotanical and socio-economical questionnaires of the human populations adjacent to the park,
- to inventory the flora of the forests, fallows, and savannas,
- to analyze the structure, diversity and dynamics of forest-fallow vegetation by phytosociological studies along forest-fallow transects,
- to characterize the regeneration potential of woody species in young fallows by dendrometric investigations,
- to propose solutions of land utilization for a sustainable management of forests as a natural resource. The obtained results are intended to be used for the development of a management program for the region.

First data obtained in fallows younger than six years show a low number of woody seedlings and a considerable number of *Anacardium* plants. The monoculture of *Anacardium* of three and more years of age and the cultural system inhibit the regeneration of forests because the plots are regularly cleared to enhance the development of *Anacardium*.

The study is part of the project W04 (phytodiversity and dynamics of habitat fragments in Côte d'Ivoire) of the BIOTA Africa program of the German Federal Ministry of Education and Research (BMBF).

Nectar production patterns of *Tibouchina grossa* (Melastomataceae) and the consequences of a shift in pollinator attractant

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Flowers of the tropical family Melastomataceae provide pollen as the only primary attractant for pollinators and show a striking mode of pollination, the so-called "buzz pollination". Pollen-collecting bees "vibrate" the anthers with the help of their thoracal flight muscels, which causes the pollen to stream out of the poricidal thecae. However, some two percent of the 3,000 neotropical melastome species produce floral nectar and, thus, receive visits by a wider variety of animals, e.g. hummingbirds and bats. The high Andean *Tibouchina grossa* represents an intermediate form not only between bat and bird pollination, but between pollen-only flowers and nectar-only flowers. This very unusual switch from pollination by pollen-collecting bees to nectar-feeding vertebrates should be accompanied by certain adaptations regarding floral morphology and nectar production, as buzz pollination requires some highly specialized prerequisites that are hardly suitable for vertebrate pollination.

Mat forming plant species and their diversity on Brazilian inselbergs

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Inselbergs are rounded rock outcrops consisting of granite or gneiss and represent old and stable xeric ecosystems that are widespread throughout the tropics. One of the most characteristic habitat types on inselbergs are mats of highly specialized vascular plants that form carpet-like vegetation islands directly on the open rock surface. Whereas mat diversity on paleotropic inselbergs is rather limited due to the dominance of certain Cyperaceae (e.g. *Afrotrilepis* or *Coleochloa* in tropical Africa), on neotropical and in particular on Brazilian inselbergs mat diversity is considerably higher.

Mats are initiated by mat forming plants, which are dry adapted and often poikilohydric or succulent. Due to their adhesive roots and clonal propagation they are able to develope dense stands on the often steeply inclined rock surface. Other mat species occur rooted in the mat substratum or as ephiphytes.

The following results are based on data obtained on 6 inselbergs in the southeast and 10 in the northeast of Brazil. Bromeliaceae, Orchidaceae and Velloziaceae are the most important mat former on Brazilian inselbergs. In the investigated areas, 35 mat formers and in total more than 80 vascular mat species out of 28 families are recorded.

Northeast and southeast Brazilian inselbergs have only few species in common, like *Xerophyta plicata* (Velloziaceae) or certain *Selaginella* species. Very characteristic for mat communities on more humid rock outcrops of the Mata Atlântica zone is a high unpredictability of the species composition (high beta diversity) indicating a strong influence of stochastic processes in colonization. In contrast, diversity of mat formers decreases towards the semiarid stretches of the northeastern Caatinga zone, with *Encholirium spectabile* (Bromeliaceae) being dominant as mat former.

The higher mat diversity in Brazil compared with African inselbergs can be explained by a larger species-pool of mat-forming, e.g. due to the presence of the dry-adapted Bromeliaceae and Cactaceae. The even larger species pool in the Mata Atlântica zone is probably responsible for the exceptional high beta diversity between different mats due to higher probabilities of stochastic colonization events.

Diversity and biogeography of Neotropical epiphytes - A comparison of Neotropical epiphyte inventories

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The present knowledge about structure, diversity, and phytogeography of neotropical forests is mainly based upon studies on woody plants, although non-woody plants contribute much to the high species richness and ecological complexity of these ecosystems. Epiphytes are extraordinarily diverse components in Neotropical forests and contribute up to 50 % to vascular plant species richness on a local scale. Biogeographical studies about this life form are scarce and based on insufficient data.

Based on our own field studies and data compiled from literature the diversity and biogeographical relationships of 16 neotropical local epiphyte inventories with comparable size and collecting effort were analyzed. Floristic similarity was calculated among all local inventories using Sorensen's Index. Basic spatial spatial relations between inventories (e.g. altitudinal difference, distance, sum of altitudinal changes) were calculated and included in a GIS based analysis.

Floristic similarity shows strongest correlation with the altitudinal difference between local floras. Floristic similarity is highest among lowland floras, whereas it is 45 % lower among montane floras and 78 % lower between montane and lowland epiphyte floras. Furthermore, floristic overlap between local floras varies strongly in different taxa. Pteridophytes contribute significantly more to floristic overlap among local floras than Orchidaceae. Cluster and factor analyses reveal four distinct biogeographical groups. Lowland floras are clearly distinct from montane floras. Among lowland floras, Central and North Eastern Amazonian floras differ from moister lowland floras close to Andean foothills of Ecuador and Bolivia and the Central American Cordillera. In general, species richness of epiphytes in lowland forests is positively correlated with annual precipitation.

We conclude that present and historic humidity patterns are a major force in structuring biogeographical patterns in neotropical vascular epiphytes, especially in the lowlands. On the other hand, Andean orogenesis and the heterogenity of abiotic factors are a major force driving speciation and causing high alpha-diversity as well as high floristic heterogenity in montane epiphyte floras. Our data show that modern taxa with high evolutionary plasticity, such as Orchidaceae, contribute most to floristic heterogenity (compare Küper et al., this conference). We also discuss how the "explosive adaptive radiation" of Andean epiphytic taxa increases epiphyte diversity in adjacent lowland regions with high annual precipitation.

This project has been generously funded by the DFG (grant Ba 605/10-1). More information is available at: www.botanik.uni-bonn.de/system/index.html.

Zur Ökologie und Diversität holzbewohnender Pilze in einem Bergregenwald Südecuadors

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Im Rahmen der DFG-Forschergruppe „Funktionalität tropischer Bergregenwälder; Diversität, dynamische Prozesse und Nutzungspotentiale unter ökosystemaren Gesichtspunkten" wurden in Südecuador auf dem Untersuchungsgebiet der ECSF (Estacion Cientifica San Francisco) die Diversität der Pilzarten aufgenommen. Das untersuchte Gebiet liegt zwischen Loja und Zamorra auf einer Höhe von 1800 bis 2400 m ü. NN. Die Pilzfruchtkörper wurden von verschiedenen Substrattypen, angefangen von kleinen Ästen bis hin zu mächtigen Stämmen verschiedenen Zersetzungsgrades, gesammelt. Da neben diesen Substratparametern für die Fruchtkörperbildung auch mikroklimatische Bedingungen entscheidend sind, wurden außerdem Begleitdaten wie Berindung, Bemoosung und Höhe über Boden aufgenommen. Mit Hilfe dieses Datensatzes lassen sich erste Aussagen zur Ökologie der holzbewohnenden Pilze treffen. So konnten Arten ermitteln werden, die nur auf entrindetem Holz fruktifizieren. Andere wurden bisher nur auf kleinen Zweigen und nie auf Starkholz angetroffen. Solche differenzierten ökologischen Daten fehlen für tropische Pilze bisher weitgehend.
Um die Diversität der Pilzarten im Untersuchungsgebiet abschätzen zu können, wurden die Aufsammlungen in Untersuchungsflächen von 400 m^2 Größe in unterschiedlichen Höhenstufen vorgenommen. Zu erwarten war ein großer Unterschied der Artenzusammensetzung in unterschiedlichen Höhenstufen, jedoch zeigen auch eng benachbarte Plots nur relativ geringe Überschneidungen des Arteninventars. Auch eine sechs Monate nach der ersten Untersuchung durchgeführte zweite Beprobung der Flächen führte zu keiner deutlichen Vereinheitlichung des Arteninventars der Plots. Somit muss davon ausgegangen werden, dass mit den bisher über 1000 Aufsammlungen nur ein Bruchteil der tatsächlichen Pilzarten-Diversität erfasst werden konnte.

Conservation conflicts across Africa: human population and hotspots of plant diversity

Wolfgang Küper, Jens Mutke, Jan Henning Sommer, Jon Lovett, James Taplin, Peter Linder, Gerold Kier & Wilhelm Barthlott

Places of particular interest for conservation are often those with a high species richness and a high probability of conversion of natural vegetation to other forms of land use. The development of conservation strategies should include a comparison of the Centres of Diversity with the spatial patterns of human settlement and land-use (Myers 2000). The aim is to identify areas of conflicting interests in respect to conservation and land-use ("Conservation Hotspots"). In this poster we compare spatial patterns of plant species richness and human population density in sub-Saharan Africa.

Our analysis is based on the largest and most representative dataset on African plants available in respect of the number of species, its taxonomic spectrum and its geographical representation. A Geographical Information System for the distribution areas of more than 4000 taxa in sub-Saharan Africa has been established. Species ranges have been modelled based on abiotic characteristics of the species habitats on a 1° resolution. Species richness was calculated by overlaying the individual ranges. Results from this taxon based approach have been validated by a comparison with the species richness of more than 420 African geographical units (Barthlott 1999, Mutke et al. in press). As done in previous zoological analyses with the same thematic focus (Balmford et al. 2001), species richness was taken as a measurement for diversity. Human impact is approximated by mean population density.

All of the known centres of species richness in subsaharan Africa (Lovett et al.) are densely inhabited by humans. Hotspots are (among others) identified between Mt. Cameroon and Douala, the Kivu area and around Nairobi and Cape Town. The "best" ratio between (high) species richness and (low) human population density is observed in central Gabon.

One decisive political argument for the selection of high priority areas for conservation is the ratio between the necessity and effectiveness of conservation on the one hand and on the other the costs caused by conservation activities. Conservation efforts will concentrate on areas with a good respective ratio (Dinerstein & Olson) and complementarily integrate irreplaceable areas (Williams). The analysis presented here can be regarded as a first step in this direction. However, in many hotspots, most of the vegetation has been completely converted by men. It is therefore necessary to estimate human impact in presence and future. Further, we have to understand the reasons for coinciding centres of plant diversity and human settlement: many hotspots are located in areas where a high Net Primary Production promotes human settlement, whereas others, e.g. tropical coastal areas are predestined as hotspots by historical reasons (e.g. accessibility).

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Life history variation of *Microcebus murinus* in different regions of Madagascar

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The grey mouse lemur (*Microcebus murinus*) is considered a typically dry forest species that is widespread in the dry deciduous forests of west and south-west Madagascar. However, some isolated population extend into the humid evergreen littoral forests of southern Madagascar. This phenomenon offers the possibility to study ecological and physiological limitations for this species and possible adaptations to the humid environment that ought to represent the environmental limit for this species. The results of the present study are compared with results from "typical" dry forest populations at Ampijoroa (northwest Madagascar: 1100 mm rain/year; e.g. Zimmermann *et al.* 1998) and Kirindy/CFPF (western Madagascar: 800 mm rain/year; e. g. Schmid & Kappeler 1998).

The study was conducted between October 2000 and February 2001 in the evergreen littoral forest of Mandena (24° 57'S; 47°00'E; 1600 mm rain/year). The time coincides with the birth season of *M. murinus*. Population dynamics were studied by mark/recapture. Standard morphometric measurements were taken as in the comparative studies. Animals were radiotracked to get an idea about home ranges of males and females and the social structure of the population.

Microcebus murinus from the littoral forest were heavier and larger in most morphometric measurements than their conspecifics in the dry forest. In the littoral forest females give birth to two or three litters per year while the animals have one litter in the dry forest of Kirindy and 1-2 litters in Ampijoroa. Males rarely use tree holes for sleeping but rather rest in the vegetation. Home ranges are larger in the humid littoral than in the dry forests. Changes in life history traits of the different populations co-vary closely with differences in annual precipitation.

In conclusion: *M. murinus* in the littoral forest differ in many traits from populations in the dry deciduous forest. The physiological bases and evolutionary consequences of these traits are being assessed in ongoing studies.

Life history of *Cheirogaleus medius* in a evergreen rain forest of south-east Madagascar

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The dwarf fat-tailed lemur (*Cheirogaleus medius*) is considered a typical dry forest species that is widespread in the dry deciduous forests of west and south-west Madagascar. However, some isolated populations extend into the humid evergreen littoral forests of southern Madagascar. This phenomenon offers the possibility to study ecological and physiological limitations for this species and possible adaptations to the humid environment that ought to represent the environmental limit for this species. Parallel studies on *M. murinus* in evergreen littoral forests showed that *M. murinus* differ in many traits from populations in the dry deciduous forest. The present study on *C. medius* in littoral forests is supposed to complement the study on *M. murinus* in order to separate species-specific from environmental constraints in the interpretations of the role of adaptations to this humid environment. In contrast to the promiscuous *M. murinus C. medius* was classified as monogamous. Hibernation in *C. medius* lasts up to 7 months beginning in April.

As the first part of an ongoing project the study was conducted between February 2002 and April 2002 in the evergreen littoral forest of Mandena (24° 57'S; 47°00'E; 1600 mm rain/year). The time coincides with the prehibernation period of *C. medius*. Population dynamics were studied by mark/recapture. Standard morphometric measurements were taken. Animals were radiotracked to get an idea about home ranges of males and females and the social structure of the population.

Similar to the situation found for *M. murinus C. medius* from the littoral forest were heavier and larger in most morphometric measurements than their conspecifics in the dry forest. Pulp of fruits species consumed contained higher concentrations of lipids and sugar than fruits that were not consumed. Prior to hibernation weight increased within 4 weeks by about 20%. At the end of April no animals could be trapped, but there were still active and not hibernating yet. Analyses of home ranges and sleeping behaviour show signs of monogamy but also of other social systems, thus matching the situation found in the dry deciduous forest. The study is funded by the DAAD.

Stoffeinträge und -austräge feuchttropischer Agroökosysteme im Vergleich zum Primärwald im Amazonastiefland Ecuadors

Norbert Lanfer (Berlin)

Das Untersuchungsgebiet der Forschungsarbeiten liegt im Oriente Ecuadors und ist seit Beginn der 70er Jahre durch einen Zuzug von Kolonisten geprägt. Die durch die Kolonisten durchgeführte Regenwaldkonversion in Agroökosysteme zieht deutliche Veränderungen bezüglich des Stoffumsatzes nach sich.

Im Vortrag werden Ergebnisse zum Stoffeintrag über Litterfall und Bulk-Deposition sowie zum Stoffaustrag über Sickerwasser und Ernte vorgestellt. Die Ergebnisse beziehen sich dabei auf die regional dominanten kleinbäuerlichen Landnutzungsysteme Kaffee, Kakao, Weide und der vor allem von Großkonzernen angebauten Palma africana. Die Stoffbilanzen werden dabei insbesondere unter dem Aspekt der standörtlichen Nachhaltigkeit der Agroökosysteme betrachtet.

Die Nährstoffzufuhr in den Agroökosystemen und im Primärwald erfolgt über eine Koppelung von systeminternen und -externen Prozessen. Kulturpflanzen nehmen in unterschiedlicher Quantität und Qualität Nährstoffe aus dem Boden auf und Speichern diese in ihrer Biomasse. Über den Litterfall gelangen die so gespeicherten Nährstoffe wieder in den Kreislauf zurück und stehen neuem Pflanzenwachstum zur Verfügung.

Da die getrennte Erfassung nasser, feuchter und trockener Deposition allgemein und insbesondere im Untersuchungsgebiet nur schwer möglich ist, wurde die Gesamtdeposition (Bulk-Deposition) erfasst. Innerhalb der Bulk-Deposition besteht ein enger Zusammenhang zwischen der Akzeptoroberfläche, der Deposition und dem Blattleaching von Nährstoffen. Akzeptoroberfläche ist vor allem die Blattfläche. Ihre Bestimmung erfolgte mit der indirekten, nicht-destruktiven Methode der „hemisphärischen Aufnahmen" und gibt vor allem einen relativen Unterschied zwischen den betrachteten Untersuchungseinheiten wieder.

Die Stoffausträge mit dem Sickerwasser sind vorwiegend abhängig vom Bestandsniederschlag, den bodenhydrologischen Kennwerten, der Mineralisationsrate, dem Speichervermögen des Bodens und der bislang noch nicht geklärten pflanzenspezifischen Mechanismen der quantitativ und qualitativ unterschiedlichen Stoffaufnahme. Auf die einzelnen Komponenten wird nicht im Detail eingegangen, sondern ihre standörtliche Summenfunktion dargestellt.

Stoffausträge mit der Ernte lassen sich vor allem für die Agroökosysteme Kaffee, Kakao und Palma africana gut belegen, während diese über den Verkauf von Schlachtvieh aus den Weidesystemen nur schwer zu quantifizieren sind. Für den Primärwaldstandort liegen diesbezüglich keine Angaben über eine Ernte von Holz- und Nichtholz-Produkten vor.

Abschliessend findet eine Bewertung der Ergebnisse zum Nährstoffeintrag und -austrag im Hinblick auf die Frage zur Nachhaltigkeit der Agroökosysteme statt. Die Ergebnisse liefern somit einen detaillierten Beitrag zu den Stoffumsätzen in tropischen Ökosystemen.

Die vorgestellten Untersuchungen fanden im Rahmen des Projektes „Wasser- und Nährstoffumsatz im Tieflandsregenwald Ecuadors – Vergleich von Primärwald mit unterschiedlichen Nutzungssystemen" statt, dessen Finanzierung von DFG und BMZ/GTZ getragen wurde.

Dynamics of the woody species composition in West African Savanna according to the perception of the local population

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In the last decades significant vegetation changes in West African Savannas due to changing climatic conditions and increasing human impact have become obvious. Whereas the dynamics of vegetation cover were intensively observed, the knowledge about changing species compositions and phytodiversity dynamics is still scarce.

The present study aims to analyse by ethnobotanical and botanical investigations the changes in woody species composition along a climatic gradient from the Sahel to the southern Sudanian Zone in Burkina Faso and Benin. As there is a lack of data on former vegetation composition the perception of local people is of special importance. Ethnobotanical investigations in different ethnic groups furnished data on the retrogression and spread of woody species and on changes in recent utilization strategies. For each study region a list of decreasing woody species was compiled. Distribution data were collected for the most affected species. Due to differences in climatic conditions and regimes of human exploitation the point in time when some of the species began to go into decline varies strongly. Furthermore information on plant use as well as the cultural relevance of the diminishing species were collected to indicate the human impact on phytodiversity dynamics and to reveal the consequences of diversity loss for the local population.

Long-term changes of the epiphyte community in Annona glabra trees of Barro Colorado Island, Panama

Stefan Laube, Steffen Schultz, Gerhard Zotz

Epiphytes comprise a large proportion of the plant biodiversity in tropical ecosystems. Different from other life forms, in particular trees, we know almost nothing about long-term changes in community composition, although the crucial importance of such data is widely recognized. For example, rare events like El Niño events may have a disproportionate impact on community structure and dynamics, but their impact on epiphyte communities is unknown, quite different to the situation in trees. Much insight into the processes that structure plant communities can be gained from long-term observations. In 1994 a census was undertaken by G. Zotz, P. Bermejo and H. Dietz on Barro Colorado Island, Panama. These researchers collected information on the community composition and the structure of epiphyte vegetation in the host tree, *Annona glabra*, a flood-tolerant, multiple stemmed tree, which is restricted to the shoreline of Barro Colorado Island and the adjacent peninsulas. The study was the first to provide a complete inventory of the epiphytes growing on a particular host tree in a large geographical area (ca. 1600 ha). Data on tree biometrics, epiphyte species, and epiphyte abundance were collected for about 15,000 individuals on more than 1,200 trees, meant to be a baseline data-set for the observation of long-term changes. In 2002, we repeated this census. Here, we present the results, documenting and discussing the changes in community composition over a period of 8 years.

Einfluss abiotischer Standortfaktoren auf Keimung und Anzucht von einheimischen Baumarten in der Zone des tropischen Bergregenwaldes Südecuadors

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Ein Grossteil der bisher in Ecuador durchgeführten Aufforstungen behandeln exotische Baumarten wie *Pinus* oder *Eucalyptus*, einheimische Baumarten blieben derzeit zumeist unberücksichtigt. Neben dem bisher weitgehend unbekannten Wuchsverhalten nativer Baumarten ist für deren untergeordnete Rolle bei Aufforstungen ebenfalls ausschlaggebend, dass derzeit nur wenig Wissen über die Anzucht nativer Baumarten vorhanden ist. Daraus resultiert eine fehlende Bereitstellung von ausreichend Pflanzenmaterial.

Das DFG-Projekt „Aufgelassene Weiden und die Möglichkeiten ihrer Aufforstung im Gebiet des tropischen Bergregenwaldes Südecuadors" befasst sich mit Aufforstungen in der Provinz Zamora – Chinchipe im Süden Ecuadors. Innerhalb dieses Projektes wurden Versuche zur Anzucht nativer Baumarten angelegt, die dazu beitragen sollen, die Wissenslücken über die Anzucht einiger nativer Baumarten zu schließen, und eine Bereitstellung von ausreichenden Mengen qualitativ hochwertigen Pflanzenmaterials für zukünftige Aufforstungen zu ermöglichen.

Die in den Anzuchtversuchen enthaltenen Baumarten (*Alnus acuminata*, *Cedrela montana*, *Myrica pubescens*, *Clethra revoluta*, *Piptocoma discolor*) sind aus Gründen der wirtschaftlichen Bedeutung sowie unter ökosystemaren und ingenieurbiologischen Aspekten für Aufforstungen auf degradierten Flächen und aufgelassenen Weiden in dieser Region von großem Interesse. Die Anzuchtversuche werden durchgeführt in der Baumschule des DFG-Projektes in der Stadt Loja, Südecuador.

Die Versuchsanlagen (Spaltanlage mit 3 Faktoren) umfassen Versuche zur Keimung und Anzucht der Pflanzen. Als Faktoren werden die Baumarten, verschiedene Beleuchtungsintensitäten sowie Substrate (Standard-Baumschulsubstrat, Standard + Beimischung von Walderde, Standard + Beimischung von Humus, Standard + Beimischung von Sand) getestet und das Verhalten der Pflanzen bzgl. Keimrate, Mortalität der Keimlinge und das Wachstum der Pflanzen untersucht.

Ziel ist es Anzuchtverfahren zu entwickeln, bei denen unter Aspekten der Massenproduktion neben den biologischen Keim- und Anzuchterfolgen auch kostenrelevante Aspekte der Anzucht einbezogen werden. Es soll auf diese Weise die praktische Umsetzung erleichtert und Empfehlungen für eine optimale Anzucht von Pflanzenmaterial für Aufforstungen mit einheimischen Baumarten gegeben werden.

Genetic diversity of Pinus masseniana in lower sub-tropical China revealed by RAPD

Quinfen Li

Pinus massoniana is a multipurpose economic tree species distributed widely in China. Due to its fast-growing trait air-planting is normally used in afforestation. The genetic resource is reckoned being changed consequently. In research random amplified polymorphic DNA (RAPD) markers were used to measure genetic diversity within and differentiation among *Pinus massoniana* in subtropical China. Concordant with previous allozyme studies, we also detected high genetic diversity within and low genetic differentiation among populations. Unexpected UPMGA cluster results indicated genetic uniformity through out South China caused by large-scale artificial afforestation. The winged seeds facilitate wind dispersal and may fly a long distance to mix with natural populations, resulting in genetic contamination.

Modeling the relationship between soil CO2 emission and environmental factors in lower subtropical China

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Soil respiration is the primary path by which CO_2 fixed by land plants returns to the atmosphere, and a key process in relation to the global change. The objective of this paper is to provide a brief scientific assessment on the effects of soil respiration, then find the relationship between land use and soil carbon sequestration, especially the influence of vegetation rehabitation. This study was conducted at the Heshan Interdisciplinary Experimental Station (112°54' E, 22°41' N), Chinese Academy of Sciences in Guangdong province, P R. China. The experimental area is typical of the region with low hills (peak elevation of 98 m) and small catchments (each having an area of about 5–8 ha). Trend surface analysis was used to quantify the soil CO_2 emission, A model which included multivariate of environmental factors was constructed as follow:

$X=0.05194X_1+0.06588X_2+0.03668X_3+0.02910X_4-0.00723X_5-0.00260X_6+0.03640X_7-2.39649$

$Y=-0.02692X_1+0.04777X_2+0.07208X_3-0.01516X_4+0.03760X_5-0.00892X_6-0.03561X_7+5.956623$

$Z_1= 589.950261X -361.233304 Y + 60.661379 X^2- 536.311504 X\times Y-115.118974 Y^2+2075.431054$

$Z_2 = 670.690726X- 276.622127 Y + 114.687170 X^2-744.721084 X\times Y-744.721084Y^2+2323.099949$

where: X and Y are public factors; both of which are synthesis of all the environmental factors. X_1 is air temperature(?); X_2 is wet-bulb temperature(?); X_3 is absolute humidity(%); X_4 is dry-bulb saturated vapor press(hpa); X_5 is relative humidity(%); X_6 atmosphere pressure (hpa); X_7 is ground temperature(?).

Z_1 is the flux of soil CO_2 emission at soil surface ($mg\cdot m^{-2}\cdot h^{-1}$), while Z_2 is the flux of soil CO_2 emission at 5cm deep in the soil ($mg\cdot m^{-2}\cdot h^{-1}$).

Key words: Forest soil CO_2 emission; Trend surface analysis; Subtropical forest soil of South China

Pollination by hummingbirds in a remnant of the Atlantic forest, northeastern Brazil

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Hummingbirds are the major vertebrate pollinators of Neotropical plants and pollination by hummingbird is found in many botanical families. Studies on pollination guilds constitutes an efficient way to understand ecological processes in natural ecosystems. During the period of May/1997 and January/1999 and August to Dezember/1999 we studied the ornithophilous guild of an Atlantic forest remnant in Pernambuco state, northeastern Brazil. Twenty seven ornithophilous plants were registered, but we included also two species that despite not being ornithophilous were efficiently pollinated by hummingbirds. Among these 29 species, 15 are Dicotyledons (11 families) and 14 are Monocotyledons (6 families), totalling 17 families and 25 genera. Bromeliaceae was the richest family with 27,6% of the guild species. Most of the species (64,3%) are epiphytes, facultative epiphytes or vines, followed by herbs (17,9%), shrubs (14,3%) and trees (3,5%). The majority showed red, red-orange or pink flowers (55,2%), with tube corollas (79,3%), measuring 31,4 mm length on average. Sugar concentration in the nectar ranged from 10,2 to 46,8% and the mean nectar volume varied from 2,5 to 97,4%. Although during the whole year one can find ornithophilous species flowering, most of them (91,7%) blooms during the rainy season. Eight species of hummingbird were registered in the community. Three of them were found to be residents, the remain were temporary. Due to the visiting behaviour, *Glaucis hirsuta* (Phaethornithinae) was considered as the dominant species. Comparisons with other studies on the same subject in southeastern Brazilian Atlantic forest and also in other neotropical areas revealed richness of ornithophilous species and interactions. (CAPES/CNPq)

Bat-pollinated flower guild in "Caatinga", a tropical dry forest in the Northeast of Brazil

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The "Caatinga" is a tropical dry forest and scrub vegetation occurring exclusively in Brazil, covering ca. 60% of the Northeast Region. Studies on bat-pollinated flora in Brazilian ecosystems are registered only for the southeastern Atlantic forest. Based on a study about the pollination systems in Caatinga pollination by bats occurs in 13.1% of the species. Analysis of the bat-pollinated plant assemblages at three Caatinga areas in Pernambuco state, northeastern Brazil is now presented. We examined species composition, plant growth habit, floral traits, including morphology, size, colour, odour and volume and sugar concentration in the nectar. Twenty native species of bat-pollinated plants, distributed in 10 families and 14 genera were recorded. The Leguminosae, Cactaceae and Capparaceae are the more representative families in number of chiropterophilous species. Only three genera are represented by more than one species. Bell-funnel and brush were the most numerous floral types. Excepting for a specie of a Leguminosae-Mimosoideae, whose flowers are small (< 10mm) and organized in a capitulum, which constitutes the pollination unit, all the 19 remaining species have their flowers individually explored by the bats. The pollination unit (flower or inflorescence) size ranged between 15 and 150 mm. The flowers are pollinated mostly by *Glossophaga soricina* during hovering visits and in a trap-line foraging pattern. *Anoura geoffroyi* and *Lonchophyla mordax* were also observed as floral visitors of some species. Photograph registers, as well as the floral and bat morphology and the visiting behaviour were used to assess pollen placement and stigma contact on the body parts of the bats. We compared our dates with those of the Atlantic Brazilian rainforest and also with other tropical communities. (CNPq)

Factors causing the loss of ant species richness with increasing altitude at Mt. Kinabalu, Malaysia

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This investigation aimed at finding possible factors responsible for the steep decline of ant species richness with increasing altitude of the tropical rainforests at Mt. Kinabalu, Sabah. We studied the altitudinal zonation simultaneously in the ground stratum as well as in the lower vegetation comprising lowland and lower montane forest (580 m – 1520 m). The results revealed a distinctly different decline pattern of ant species richness in these two strata. The decline of ant species richness correlated highly significantly with the decrease of temperature in each stratum, thus pointing to temperature as a decisive factor for the decline.

The ant species richness, and especially ant abundance and biomass of the ground stratum, decreased steeply along the altitudinal gradient within the lowland forest (< 1200 m). This most species-rich forest type was assumed to provide constant abiotic and biotic conditions, apart from the temperature. Therefore we concentrated on the lowland forest (580 m–1140 m). To obtain information about the nesting ecology and other ant life habits with increasing altitude, ant nests were sampled on the ground and in the lower vegetation. Furthermore we recorded several abiotic and biotic parameters in both strata as well. Nest density remained the same up to 1000 m in both strata and then decreased significantly up to 1140 m. Dead wood was the most important nesting resource for ants in both strata. On the ground the relative number of nests in dead wood increased with altitude up to 1000 m, while other nesting types decreased. However the abundance of suitable dead wood did not change along the gradient and our data indicate that top soil consistency, humidity and temperature might be more important factors for the drop in soil nest density.

Beside a significant change of abiotic conditions of the ground layer, a high turn over of plant species between 800 m and 1200 m (Kitayama 1992) and an increasingly clumped ant distribution in the lower vegetation (indicating a reduction of food resources such as floral nectaries and trophobionts), are assumed to be additional factors causing the decline of ant species richness.

Moreover we investigated several ecological parameters of a single ant species, *Diacamma* sp., occurring in a broad altitudinal zone. With increasing altitude distances between colonies increased, digging efficiency of the ant workers decreased and there were visible changes in the nest construction. This might point to an increasing scarcity of food and it might furthermore reflect direct effects of decreasing temperature.

Kitayama, K. (1992) An altitudinal transect study of the vegetation on Mount Kinabalu, Borneo. Vegetatio 102, 149-171.

Funktion und Bewertung der organischen Substanz in Böden lateinamerikanischer Bergnebelwälder

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Im Rahmen dieser Präsentation wird die Bedeutung der organischen Substanz in tropischen Bergnebelwäldern erarbeitet. Grundlage liefern Untersuchungen der Abt. Landschaftsökologie der Georg-August-Universität Göttingen in Bergnebelwäldern in Guatemala und Bolivien, mit Fragestellungen zur geoökologischen Differenzierung und zur Biodiversität der jeweiligen Region.

In Guatemala wird im Rahmen des Graduiertenkollegs „Wertschätzung und Erhaltung von Biodiversität - Umsetzung von Naturschutzstrategien im Rahmen des Übereinkommens über die biologische Vielfalt" eine GIS-gestützte Bewertung von Landnutzungspotential und Landschaftsstruktur zur Schutzgebietsausweisung in Bergnebelwaldgebieten durchgeführt.

In Bolivien wird der „hypsometrische Wandel naturnaher Bergregenwaldökosysteme in den Yungas" untersucht. Projektziel ist die Untersuchung der für die Vegetationszonierung maßgeblichen ökologischen Wechselwirkungen zwischen biotischen und abiotischen Faktoren anhand einer Transektstudie.

Die Böden der untersuchten Bergnebelwäldern sind jeweils geprägt durch extreme Versauerung (pH/KCl < 4,5; im O- und A-Horizont < 4,0), z.T. sehr geringe $KAK_{eff.}$ (< 5 cmol/kg), hohe Al^{3+}-Sättigung (> 70%) und ein weites C/N-Verhältnis (> 15). Die organische Substanz hat bei diesen nährstoffarmen Bodenbedingungen die entscheidende pflanzenverfügbare Nährstoffspeicherfunktion. In Bolivien sind z.T. mächtige Auflagehorizonte (Feuchtrohhumus) zu verzeichnen, welche im Untersuchungsgebiet in Guatemala wesentlich geringmächtiger sind. Die intensive Durchwurzelung dieser Bereiche bestätigt die elementare Bedeutung für die Nährstoffversorgung der Pflanzen in diesen Bergnebelwaldökosystemen.

Die Reduzierung der organischen Substanz im Boden durch die traditionelle Landnutzung der Q'eqchi'-Bevölkerung in Guatemala führt zu einer Instabilität der Ökosysteme (Abfolge beim Gehalt organischer Substanz in Guatemala: Primärwald > milpa 15 Jahre > milpa 25 Jahre > milpa 60 Jahre > Sekundärbusch > Brache) [milpa=Mais-/Bohnenanbau].

Eine adäquate Bodennutzung muss eingeführt werden, die die Grundlage für eine nachhaltige Entwicklung liefert. Alternative Anbauformen sowie eine landwirtschaftliche Produktionssteigerung sind Grundvoraussetzungen für den Schutz benachbarter naturnaher Ökosysteme.

Einfluss des Klimawandels auf die Kakteenflora des südlichen Nordamerika

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Areale von Pflanzenarten reflektieren die klimatischen, geomorphologischen und ökologischen Gegebenheiten der Standorte, an denen die Taxa vorkommen. Klima ist ein limitierender Faktor für die Ausprägung der Areale, was durch die vielfach belegte enge Korrelation von klimatischen Isolinien und Arealgrenzen bestätigt wird. Daher können Klimaänderungen, wie sie derzeit aufgrund des Treibhauseffektes für die Zukunft prognostiziert werden, auch zur Verschiebung von Arealgrenzen führen.
Die artenreiche Familie Cactaceae, endemisch für den amerikanischen Kontinent (mit Ausnahme einer Art), ist besonders durch die Stammsukkulenz, als morphologische Anpassungen an aride Standorte, gekennzeichnet. Die Unterfamilie Cactoideae hat mit den Triben Pachycereeae, Cacteae, Echinocereeae und Hylocereeae einen Diversitätsschwerpunkt im subtropischen Nordamerika. Innerhalb dieser Gruppe besitzen die verschiedenen Wuchsformen (Säulenkakteen, Kugelkakteen und Epiphyten) unterschiedliche ökologische Präferenzen, die sich auch geographisch differenzieren lassen. Temperatur und Niederschlag weisen dabei eine hohe Korrelation mit der Verteilung einzelner Kakteentaxa auf.
Untersucht wird die Relevanz verschiedener ökologischer Faktoren für die Ausprägung der Areale der Cactoideae im südlichen Nordamerika. Diversitätsrasterkarten für verschiedene Gattungen und Wuchsformen der Cactoideae werden im GIS mit Klima-, Boden- und geomorphologischen Daten verschnitten, um die Korrelation von Arealen und großräumigen Standortbedingungen zu analysieren. Ziel der Studie ist, die Areale zu modellieren, um daraus unter Berücksichtigung des prognostizierten Klimawandels eine mögliche Veränderung der Kakteenflora und der Areale in der Zukunft abzuleiten.

Ecology of a phyllostomid bat foraging over water: Activity pattern and ranging behavior of the long-legged bat, *Macrophyllum macrophyllum*, in Panama

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We studied home ranges, patterns of range use and activity of four male and five female long-legged bats, *Macrophyllum macrophyllum* (Chiroptera: Phyllostomidae) in the Barro Colorado Nature Monument, Republic of Panama, from April to July 2002 using radio-telemetry. Average home range size of males (16.7 ± 9.0 (SD) ha) was smaller than for females (62.3 ± 55.2 ha). The difference was, however, not significant. Except for occasional commutes through the forest en route to their foraging areas, hunting activity of the bats was essentially restricted to the immediate shoreline of Lake Gatun. Foraging areas ranged from 1.4 to 47.9 ha, again with no significant difference in size between the sexes (males: 9.4 ± 6.7 ha, females: 17.6 ± 17.9 ha). Individual bats showed high fidelity towards these foraging areas, usually revisiting them every night. Maximum distances traveled varied from c. 450 to 7450 m with males typically foraging much closer to the day roost than females. Mean minimum cumulative distances flown per night differed significantly between males and females (6992 ± 2901 m vs. 11310 ± 3264 m). The bats showed a bimodal activity pattern characteristic of many tropical and temperate zone insectivorous bats with a distinct peak in activity around dusk and a second though lower maximum before dawn. While there was significant variation among individuals, overall activity levels did not differ significantly between sexes. On a nightly basis, males on average spent 189 ± 49 min foraging, in females mean cumulative flight time per night was 201 ± 55 min. The observed decline in overall activity level in the middle of the night is largely attributable to increasingly longer hanging times that the bats spent in the roost before they resumed activity again before dawn. *M. macrophyllum* typically foraged in continuous flight (mean duration 7.2 ± 3.9 min, max. 61 min), resting phases averaged 15.3 ± 8.2 min and lasted up to three hours. Duration of foraging flights varied significantly between individuals, but again there was no significant gender-specific difference. Time of emergence and return to the day roost were significantly correlated with time of local sunset and sunrise, respectively. For males we found a negative correlation between activity level and moon shine duration whereas such lunar phobic behavior was not apparent in females suggesting that the two sexes may respond differentially to constraints such as predation risk. Cumulative flight time per night was significantly lower during rainy vs. dry nights. In this context, heavy rain substantially reduced flight activity or bats stopped foraging completely. In contrast, dripping or light rain did not markedly suppress activity levels. The telemetry data and direct observations in the field substantiate prior field observations by other authors that *M. macrophyllum* employs two distinct foraging strategies: gleaning of insects from the water surface and capture of aerial insects at low heights above water.

Space use, activity pattern and mating system of the Black Tailed Tree Rat (Thallomys nigricauda)

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Within BIOTA – South Africa project we investigate the biology of the arboreal Black Tailed Tree Rat (*Thallomys nigricauda*). From scattered notes in the literature this species was supposed to live in small family groups, each group centred around one suitable nesting tree. Thus, the distribution and spatial pattern of suitable trees (e.g. trees with sufficiently sized cavities) and shrub cover around nesting trees should influence the population biology of this rodent. We hypothesized that the intensive grazing of savannahs by domestic cattle and the associated increase of thorny shrubs (called "shrub encroachment") should increase the connectivity between otherwise isolated family groups and influence population structure on larger spatial scales. We initiated extensive fieldwork to analyse the population structure of the Black Tailed Tree Rat in correlation to vegetation structure in the southern Kalahari Thornveld, South Africa (25° 50′ S, 22° 55′ E). Mark-recapture techniques and radio tracking were carried out to investigate the use of space as well as diurnal activity patterns of males and females (see also Eccard, Meyer and Sundell 2002). The following results appeared:

1. Densities of Acacia Rats ranged from 0.1 up to 8 animals per ha.
2. Males were very mobile during night with home ranges between 5 and 10 ha during the breeding season in summer, and 1 to 2 ha during winter. Females used home ranges between 0.01 and 0.03 ha during summer and up to 0.3 ha in winter. Furthermore, the average home ranges of males were much larger than expected for a rodent of comparable body size from general allometric relationships between home range size and body size.
3. Females foraged only around one nesting tree, especially when they raised pups. Males used several nesting trees and day hides. Home ranges of individual males overlapped considerably with those of other males and the home ranges of males included nests of several females. This suggests that the Black Tailed Tree Rat has a polygynous mating system.
4. During the breeding season activity peaked just after sunset, around midnight and just before sunrise. The overall activity in males (69 %) was higher than in females (43 %). During the non-breeding season overall activities were similar between males and females (44 % in males and 42 % in females). Percentages indicate proportion of bearings outside the nest or day hides, respectively.
5. Beside these data on the behavioural ecology of the Black Tailed Tree Rat we collected data on landscape structure and rat densities on farmlands with different management regimes. We found no simple correlations between distribution and quality of certain landscape elements (e.g. density of suitable nesting trees) and density of Black Tailed Tree Rat.
   Overall our results suggest that the mating system as well as the home range sizes of Black Tailed Tree Rats do not match the assumptions of our working hypothesis. Future work will concentrate on the population genetics and population viscosity to analyse the link between the behaviour of individuals on a small spatial scale to population structure on larger scales.

- Eccard, J; Meyer, J and Sundell, J. (in press). Mating system, space use, and circadian activity pattern of nocturnal tree rat *Thallomys nigricauda*. Journal of Mammalogy

Does forest fragmentation affect the quality of the harvest of a dominant herbivore? Evidence from leaf traits

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As much as 50% of the original extent of tropical forest may have been lost to deforestation in the last two decades. In consequence, habitats are destructed, formerly continuous forests are isolated, and edge effects are created within a boundary zone between forest and deforested areas. In particular, the species composition of plant and animal communities of forest fragments are subject to considerable changes. For example, it is known that the proportion of fast-growing pioneer tree species increases. As pioneer species are generally assumed to be less defended against herbivores than slow-growing shade tolerant species, fragmentation may have an influence on trophic interactions, e.g. on theabundance of herbivores.
In the present study we asked if the increased density of leaf-cutting ants in forest fragments (see other contributions to this meeting) can be related to such changes in ressource quality. We assumed that physical leaf traits are affected by forest fragmentation and, in consequence, may change foraging conditions for leaf-cutting ants in forest fragments versus continuous forests.
Based on published data of leaf properties of pioneer trees, we hypothesized that the leaves harvested by leaf-cutting ant colonies in fragmented forests show 1) lower leaf thoughness, 2) higher leaf thickness, 3) higher specific leaf area (SLA), and 4) higher water content than leaves harvested by colonies in the continuous forest. Preliminary results suggest that, indeed, in the fragmented forest thickness and water content were higher but leaves were softer with a higher SLA than in the continuous forest.The fact that mean leaf toughness in the harvest of continuous forest colonies was lower than in the colonies from fragmented forests may suggest an increased discrimination of tough leaves and, hence, increased foraging costs in undisturbed forests. This is supported by the evidence of increased length of foraging trails in continous forest colonies (see Urbas *et al.*, this volume).

Effect of tannin and total phenols on the feeding preference of a spezialized herbivore

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Stick insects of the neotropical species *Metriophasma diocles* WESTWOOD have previously been shown to feed exclusively on plants of the *Piperaceae* and *Araceae* The feeding preferences among different *Piper*-species could neither be explained with physical plant defense mechanisms (toughness, SLA) nor with the presence of alkaloids (i.e. qualitative defense). Therefore the species was suggested to be a relatively specialized herbivore. Because qualitative compounds are thought to be primarily directed aga inst generalist herbivores we hypothesized that host plants of *M. diocles* are defended by quantitative secondary metabolites (e.g. phenols) which address towards all herbivores (Rhoades & Kates 1976). Further, a mixture of such defensive compounds is generally expected to have a higher impact on the feeding of a herbivore than a single compound (Howe & Westley 1988).

In the present study we conducted dual-choice feeding-trials to assess the effect of quantitative defenses on the feeding preference of the specialized herbivore *M. diocles.* To separate between the effect of a mixture and a single compound we increased (1) total phenols and (2) tannin concentrations. Total phenols and tannin contents were manipulated by infiltration of phenol extract of the host plant and tannin solution into leaf disks of *Piper hispidum* (*Piperaceae*).

Both the increase of tannin and total phenols showed a negative effect on feeding rates of *M. diocles.* As expected total phenols as a mixture of defensive compounds proofed to be more effective than a single compound of the same group (i.e. tannin). An increase of 0,5% total phenols (tannin-equivalent in dry weight) resulted in increased rejection, whereas an infiltration of 1,2% tannin did not show significant effects (total rejection at increased tannin content of 11,7%).

We conclude that selection of *Piper* host plants by the specialist herbivore *M. diocles* is influenced by mixtures of quantitative rather than single defense compounds. As total phenols affected the herbivore at significantly lower concentrations plant defense may function at lower costs, by investing in a mixture of different low concentrated compounds rather than accumulating one compound at high concentrations. Our results further suggest that the previously observed feeding pattern of *M. diocles* among species of the *Piperaceae* may be connected to the content of total phenols.

Adaptations in the feeding apparatus of Alestiidae (Teleostei, Characiformes)

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Different feeding modes can be found in the African characiform family Alestiidae (Ostariophysi). The majority feeds on aquatic or terrestrial invertebrates supplemented by plant material, some are specialising in feeding on sturdy plant material and others are predominantly piscivorous or microphagous. The diet, however, differs not only from species to species but also intraspecifically between growth stages and seasons. Accordingly representatives of the Alestiidae possess different types of teeth and jaw mechanisms depending on their specific feeding modes.

This different types of jaws and teeth were investigated by clearing and staining techniques and compared with the feeding habits of the different species using stomach analyses.

Those species that are less specialiced in relation to their diet, e.g. *Arnoldichthys spilopterus* possess tri- to multicuspidate teeth resembling that of many American characiform families. Species with a higher degree of herbivory are featured by a higher degree of jaw occlusion to cut the plant material, e.g. *Alestes baremoze*. Even complete occlusion is found, e.g. in *Brycinus macrolepidotus*. Alestiidae, however, have not developed any grinding mechanism in the jaw, as to be found in the South-American Myleinae, nor in the branchial apparatus, as in most cypriniforms or some specialised percomorph taxa, as sparids or labroids. The piscivorous *Hydrocynus* changes its tooth shape during the ontogeny from conical in larvae to tricuspidate in juveniles and again to conical in adults. Whilst the teeth of the juveniles resemble that of other species of the familiy, the conical teeth in the adults conform to that of other not closely related fish feeding characins.

No member of the Alestiidae has teeth on the maxillary. This bone lies medial to the anterior circumorbitals when the mouth is closed, but rotates anteriorly when the lower jaw moves downwards to narrow the ingestion opening laterally. An additional, and unusual mechanism to lift the premaxillary is only found in the genus *Hydrocynus* within the Alestiidae.

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Influence of land use systems and rain variability on carbon balance and food security in upper Ouémé catchment in Benin

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Rain variability associated with inadequate land use systems has become the most important factor for determining food insecurity and emission of (global) greenhouse gases in Benin. These aspects were analysed through data collection on biomass production, which is the ultimate source of food supply for human and whose management influences the climate change through release of carbon into the atmosphere. In the upper Ouémé catchment in Benin, the villages of Dogué and Sérou were selected respectively according to two criteria: villages, with and without land to clear. Four land use systems have been determined in each village: forests, fallows, cashew plantations and seasonal crops. Preliminary results of this research show, that the rainwater use efficiency (calories/m^3, kg biomass/m^3 or kg carbon/m^3 water) is lower for crop season 2001 (high rain variability) than for a normal rain season (crops season 2002). Decreasing precipitation is also leading to significant food insecurity and carbon release. Therefore, farmers in Benin need efficient water management systems to achieve their food security, otherwise they are obliged to extend their agricultural areas or to immigrate towards less occupied regions. The study found out that the two alternatives combined with bush fire leads to negative carbon balance (carbon source) in different land use systems. They reduce and burn the biomass production and consequently release the carbon, which accelerates the climate change. Hope is coming from impressive increases in cashew nut acreages encompassing total bush fire control and microclimate buffering all together with regular cash income.

Forest resources in South Ethiopia – a functional approach to biodiversity

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During the last two years, soil scientists, foresters, plant physiologists and biogeographers from Ethiopian and German research institutions (Addis Ababa University, Ethiopian Agricultural Research Organisation (EARO) and University of Bayreuth, sponsered by DFG and DAAD) tried and still try to contribute to a better understanding of the functioning of natural forests and forest-plantations with exotic tree species (Eucalyptus, Pinus and Cupressus div.spec.). The expected outcome will include a guideline for the local foresters, comprising recommendations on how to manage these forests and plantations in the future and how to protect remaining parts of the lesser untouched parts of the natural forest.

To achieve these objectives, sufficient knowledge about the different land-use systems and agricultural practises of the population living close to the forests, about their socio-economic and political conditions and about their special demands concerning timber- und non-timber products out of these forests is absolutely necessary. In this respect, we regard these different products as elements of a „functional biodiversity". We try to show, that many forest products have a direct function for the daily life of the population. People depend on the forest resources, especially living in remote places, far from the next market and with a very restricted economic potential.

Here we present a list of these products. All detailed information concerning land and forest use has been collected directly from the population, living not further away than 5 km from the forest margins. More than 10 families (older men and women, sometimes „opinion leaders" of a village) have been asked questions about form and extent of land-use, forest-use (timber- and non-timber products, e.g for the construction of huts, the production of tools for land-use and household items). In addition, plant-products out of the forests and also products from cultivated plants have been listed at the only important market place in the study area.

It becomes evident, that there are close relations between the use of forest products and the economic situation of the population and that further forest degradation can only be stopped, if the needs of the population can be satisfied in a sustainable way or by non-forest substitutes.

Contrasting global biodiversity patterns of ancient and modern vascular plants - angiosperms vs. gymnosperms

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We present a complete revision of our world map of species numbers of vascular plants based on a refined methodology and additional data. More than 3100 data records with species numbers for c. 2300 geographical units were analysed in an inventory based diversity mapping approach. In addition, we mapped the distribution of the c. 820 gymnosperms on a global scale and analysed the diversity patterns of this ancient subgroup of vascular plants.

Global centres of vascular plant species richness are Chocó-Costa Rica, Tropical Eastern Andes and North Western Amazonia, Atlantic Brazil, Eastern Himalaya-Yunnan, Northern Borneo, and New Guinea. The main centres in Yunnan/Sichuan, Northern Borneo, and New Guinea are the same for gymnosperms. However, in other parts of the tropics and subtropics only low gymnosperm diversity exists, with exception of Mexico and California where almost similar species numbers compared to SE Asia can be found. The European maximum of gymnosperm species richness is located in the Balkan area.

Contrasting and correlating the diversity patterns of vascular plants with maps and data on geodiversity (the diversity of the abiotic environment), close relations to, e.g., topodiversity and climate diversity are evident. Global latitudinal gradients of vascular plant species richness are compared at different longitudes.

Epiphytic lichen and bryophyte diversity along a gradient of anthropogenic disturbance in a montane rain forest in southern Ecuador

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Tropical montane rain forests, especially those of the northern Andes, harbour a very high diversity of epiphytic lichens and bryophytes. These forests are increasingly exposed to human disturbance and are disapppearing rapidly. In spite of this, studies on the effects of anthropogenic disturbance on the lichen and bryophyte diversity of these forests are very scarce.

Our investigations, carried out since May 2001 within the framework of the multidisciplinary DFG-project "Funcionality in a tropical mountain forest: diversity, dynamic processes and use-potential under ecosystems aspects", are dealing with lichen and bryophyte diversity along a gradient of anthropogenic disturbance in the montane belt (ca. 1900 m) in the Reserva Biológica San Francisco, southern Ecuador. The principal objectives of our research are 1) to determine the diversity patterns of epiphytic lichens and bryophytes in primary and secondary forest and on isolated trees, and 2) the identification of species or groups of species as indicators of a disturbance. To this purpose, 30 trees in the different forest types were sampled, from the tree base to the outer parts of the crown, resulting in 750 releveés. In addition, measurements of the microclimatic conditions (light, air humity, temperature) in selected trees have been carried out.

The preliminary results reveal a gradual change of the lichen and bryophyte species composition along the gradient of anthropogenic disturbance, due to changes in microclimatic conditions within the trees. In addition, we have observed marked distributional shifts of canopy epiphytes towards lower heights on the trees in disturbed forests. Our results agree with data from other recent studies in tropical montane forest carried out by our research group (e.g., Acebey et al. 2002).

References:

Acebey, C., Gradstein, S. R. & Krömer, T. (in press): Species richness and habitat diversification of corticolous bryophytes in submontane rainforest and fallows of Bolivia. Journal of Tropical Ecology 18.

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Räumliche Verteilung der Kronentraufe in Abhängigkeit der Kronenstruktur in einem tropischen Bergregenwald

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Im Rahmen der DFG-Forschergruppe „Funktionalität in tropischen Bergregenwäldern; Diversität; Dynamische Prozesse und Nutzungspotentiale unter ökosystemaren Gesichtspunkten" wird im Untersuchungsgebiet Estation Cientifica San Francisco, einem tropischen Bergregenwald im Süden Ecuadors, plotbasiert und rasterbezogen, Kronentraufe gesammelt und analysiert. Dieser sehr heterogene Wald am Rande des Podocarpus-Nationalparks gibt die Möglichkeit, auf kleiner Fläche sehr unterschiedliche Waldstruktur-typen zu beproben.
Ziele dieser Versuche sind die Beschreibung der Heterogenität der Kronentraufe als bestandesinternen Stoffffluss und die Erfassung von Parametern, die diese Heterogenität erklären. Damit ergeben sich folgende Schwerpunkte:
a) die Erfassung der räumlichen Heterogenität der Kronentraufe,
b) die Beschreibung der Waldstruktur und der Kronenstruktur.

Die Versuche finden auf 400m^2-Plots statt, die zu je dreien entlang eines Gradienten verschiedener Waldareale angeordnet sind: Von den neun angelegten Plots befinden sich drei an einer Flusssenke, also in einem eher feuchten und wettergeschützten Gebiet. Drei weitere Plots liegen auf den gleichen Höhen (um ca. 2000m ü.n.N.) in einer Kammlage, das heißt einem relativ trockenen und wetterexponierten Standort. Die drei Plots auf ca. 2200m liegen auf einer Ebene, die eine viel lichtere und niedrigere Waldstruktur aufweist. In allen Plots wurden in einem Raster von 5 m-Abständen je 9 Kronentraufen-Sammler aufgestellt und beprobt. Um eine bessere geostatistische Auswertung zu ermöglichen, sind in drei Plots noch vier weitere Regensammler aufgestellt. Damit ergibt sich eine Stichprobengröße von 31 Sammlern je Waldtyp.
Die Waldstrukturparameter auf Artebene werden im Rahmen der Arbeiten von Jürgen Homeier, Universität Bielefeld, bestimmt. Um zusätzliche Erkenntnisse über die Kronenstruktur zu gewinnen, wurden über allen Sammlern hemisphärische Photographien aufgenommen, die Kronen vermessen. Als weiteren Waldstrukturparameter wurden vor Beginn der Versuche unter jedem Sammler in verschiedenen Tiefen Bodenproben genommen und analysiert.

Die Datensätze über die Wasser-Flüsse zeigen schon eine auffällig hohe Variabilität in dem räumlichen Raster. Die Heterogenität der Kronentraufe liegt bei einzelnen Regenereignissen im Bereich zwischen 0,4% und fast 500% des Freilandniederschlags.
Die Quantität und Qualität der Bestandesniederschläge sind in den drei Waldtypen meist signifikant unterschiedlich.
Die Analysen zeigen in den ersten Ansätzen, dass die Muster der Elementgehalte der Kronentraufe sich in den Mustern der Elementgehalte der Bodenproben widerspiegeln.

Shifting Cultivation der Matsiguenka Indianer im Manu Nationalpark Peru

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Shifting Cultivation ist die traditionelle Wirtschaftsweise in den Tropen, bei der Ackerflächen nach einigen Jahren der Bewirtschaftung über mehrere Jahre brach liegen. Untersucht wurden Veränderungen dieser Wirtschaftsweise der im Tiefland gelegenen Matsiguenka-Dorfgemeinschaften Tayakome und Yomibato im südöstlichen Peru. Animiert durch protestantische Missionare siedelten sich die ehemals in Familiengruppen umherziehenden Matsiguenka in den sechziger Jahren in Dorfgemeinschaften im heutigen Gebiet des Nationalparks Manu an. Auf Grund von sehr weiten Entfernungen zu Siedlungen oder Städten sowie strengen Gesetzen des Nationalparks, leben die Matsiguenka der beiden Dorfgemeinschaften fast ausschließlich von traditioneller Subsistenzwirtschaft. Die Bewirtschaftung der etwa 0,5 ha großen Ackerflächen erfolgt überwiegend auf Inceptisolen der mittleren bis höheren Flussterrassen. Bewirtschaftet werden die Felder mit etwa 60 verschiedenen, essbaren Kulturpflanzen. Die wichtigste Kulturpflanze ist Maniok, die in etwa 65 verschiedenen Sorten angebaut wird. Aktiv bewirtschaftet werden die Ackerflächen in den ersten beiden Jahren, anschließend liegt die Fläche brach, nur einige Fruchtbäume werden auch nach Aufgabe der Flächen genutzt. Die Wirtschaftsweise der Matsiguenka ist sehr traditionell, dennoch werden Veränderungen in der Art und Weise der Bewirtschaftung sowie der kultivierten Arten und Sorten durch die Ansiedlung in Dorfgemeinschaften sowie vermehrten Kontakt zu Siedlern außerhalb des Nationalparks beobachtet.

Regeneration of threatened woody species in East Burkina Faso

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In the eastern region of Burkina Faso many woody species are in regression due to changing climatic conditions and rising human impact. It became obvious that especially the regeneration of the woody plants is increasingly disturbed. For more detailed information the natural regeneration of five important woody species (*Pterocarpus erinaceus, Burkea africana, Boswellia dalzielii, Securidaca longepedunculata, Pericopsis laxiflora*) was investigated. In addition germination tests for two of these species were conducted. All of the investigated species are hampered in their regeneration. Most of their stands are characterised by the quasi-absence of individuals of stages intermediate between seedlings and adults. The in-situ rate of germination is weak, for certain species in some stands even absent. Seedlings of all investigated species show a high mortality rate, as they are often not vigorous enough to survive frequent bush-fires, dryness and pasture. Germination tests at the laboratory however show a good germination and growth rate of the seedlings of *Pericopsis laxiflora* and *Securidaca longepedunculata*. One of the adaptive strategies developed by several of the investigated species is vegetative multiplication by root shoots. By this more vigorous young plants result which are able to better resist the various influencing factors. In the majority of the cases the rare individuals of the intermediate class constitute root shoots.

Überschwemmung als Ursache phänologischer und physiologischer Veränderungen bei Keimlingen amazonischer Überschwemmungswälder

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Durch periodische Wasserstandsschwankungen sind die Bäume amazonischer Überschwemmungswälder jedes Jahr bis zu 210 Tage geflutet. Keimlinge sind dann, je nach Lage im Überschwemmungsgradienten und je nach ihrer Größe, im Wurzelbereich vernässt oder vollständig überschwemmt. Bei adulten Bäumen finden in der Überschwemmungsphase Wachstumsreduktionen statt, die sich in Form von Jahresringen zeigen. Die Photosynthese-aktivität sinkt zunächst, steigt aber vor Ende der Flut auf Werte, die mit denen der terrestrischen Phase vergleichbar sind. Auch Laubwurf findet bei Vernässung vermehrt statt, aber es ist schwer, im Freiland die für den Laubwurf verantwortlichen Faktoren herauszufiltern. Zwar verlieren laubwerfende Arten bei auflaufendem Wasser ihre Blätter, aber sie treiben auch viele Wochen vor Flutende wieder neue Blätter aus.
In zwei zeitlich versetzten Flutexperimenten mit Keimlingen vor Ort wurde untersucht, inwiefern Vernässung, Submersion oder Trockenstress direkt für den Laubwurf und physiologische und morphologische Veränderungen verantwortlich sind. Dabei wurden sechs Arten mit unterschiedlichen Wachstumsstrategien ausgewählt (Laubwerfer / Immergrüne, Pioniere / Nicht Pioniere). Ein Experiment wurde zur Zeit der höchsten Niederschläge und beginnender Überschwemmung durchgeführt, das zweite in der Phase höchster Überschwemmung und beginnender niederschlagsarmer Zeit.
Mit Ausnahme der laubwerfenden Arten, die bei Vernässung in den zwei Experimenten ein unterschiedliches Verhalten zeigten, waren alle Ergebnisse der beiden Experimente vergleichbar und zeigten, dass die morphologischen, phänologischen und physiologischen Veränderungen durch die Flut- oder Trockenheitsbedingungen ausgelöst wurden. Höhenwachstum und der Austrieb neuer Blätter waren bei Vernässung kaum reduziert. Alle vernässten Keimlinge brachten Adventivwurzeln, Lentizellen und / oder Stammhypertrophie hervor. Submersion und Trockenheit verursachten eine Ruheperiode, die aber durch schnelles Höhenwachstum nach Ende der Stressphase kompensiert wurde. Schon 5-12 Wochen nach Ende der Stressbedingungen hatten die Keimlinge die Höhe der Kontrollpflanzen erreicht. Dies zeigt, dass die meisten Arten in der Lage sind, sich trotz der extremen Bedingungen effektiv zu etablieren. Das Verhalten der laubwerfenden Arten zeigt jedoch auch, dass die phänologischen Rhythmen der Bäume nicht von der Überschwemmung alleine gesteuert werden. Im Gegensatz zu den immergrünen Arten, welche die Blattproduktion bei Vernässung in beiden Experimenten gleichermaßen reduzierten, und wo die Flutbedingungen die Phänologie zu triggern scheinen, trat bei den Laubwerfern die laublose Phase nur in einem Experiment auf, und zwar zeitgleich zu der im Freiland. Hier sind also genetische oder andere Faktoren eher steuernd als die Überschwemmung.

Das Institut für Biodiversität – Netzwerk e.V. (ibn)

Das 1990 gegründete Institut für Biodiversität - Netzwerk e.V. Wissenschaft und Wirtschaft (**ibn**) mit Geschäftsstellensitz in Regensburg, Friedrichshafen und Straubing, konzentriert seine Forschungs- und Beratungstätigkeit auf Fragen des Schutzes und der nachhaltigen Nutzung biologischer Vielfalt. Die Netzwerkstruktur führt ausgewiesene Experten unterschiedlicher Fachrichtungen und Sektoren zusammen und ermöglicht eine stark interdisziplinär orientierte Arbeitsweise. Der satzungsgemäße Zweck des **ibn** ist die *Gewinnung, Anwendung und Verbreitung wissenschaftlicher Erkenntnisse, welche die Bewahrung, Wiederherstellung und die nachhaltige und verteilungsgerechte Nutzung der biologischen Vielfalt* zum Ziel haben.

Die **ibn**-Netzwerkmitglieder – freie Mitarbeiter, Experten aus der öffentlichen Forschung und Kleinunternehmen – arbeiten in Partnerschaft auf Zeit projektbezogen unter Koordination des **ibn**-Teams zusammen.
Das **ibn** ist als gemeinnützigen wissenschaftlichen Zwecken dienend anerkannt und finanziert sich durch Mitgliedsbeiträge, Beiträge von Institutionen der allgemeinen Wissenschaftsförderung, durch Erträge aus der satzungsgemässen Tätigkeit und durch Spenden, Schenkungen und sonstigen Zuwendungen.

Aktuelle Projekte (Auswahl)

- **Die Konvention zur Biologischen Vielfalt (CBD).** Das **ibn** bezieht sich in seinem Satzungszweck explizit auf den Ziel-Dreiklang der Konvention über die biologische Vielfalt (CBD), deren Begleitung, Weiterentwicklung und Umsetzung sich das Institut u.a. zur Aufgabe gemacht hat. Das **ibn** hat an allen Vertragsstaatenkonferenzen und an allen Sitzungen des wissenschaftlichen Beirates der CBD teilgenommen, in der Hälfte der Fälle als Teil der offiziellen deutschen Delegation.

- **F & E-Vorhaben für das UBA „Berücksichtigung von Biodiversitätsaspekten bei Klimaschutzmaßnahmen"** Ziel des Projektes ist eine Zusammenstellung und Auswertung von geigneten Kriterien, Indikatoren, UVP und dergleichen für die notwendige Berücksichtigung von Biodiversitätsaspekten bei Klimaschutzmaßnahmen

- **F & E-Vorhaben für das UBA „Bewertung der Umweltwirkung von gentechnisch veränderten Organismen (GVO's), Umsetzung des Biosafety-Protokolls"** Das Projekt erstellt Bewertungsgrundlagen zu Umweltwirkungen von GVO's, die auch als Beiträge für den Aufbau des deutschen Biosafety Clearing House Mechanismus im Rahmen des Biosafety-Protokolls der CBD dienen.

- **F & E-Vorhaben für das BfN „Erstellung von Konzepten zur Nachhaltigen Nutzung in ausgewählten Teilbereichen der biologischen Vielfalt"** Ziel des Projektes ist es zu untersuchen in wieweit die Nachhaltigkeitsprinzipien des ökosystemaren Ansatzes der CBD in den Sektoren Wald, Berggebiete und Schutzgebiete in Deutschland Berücksichtigung finden.

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Correlations between soil properties and vegetation patterns at one selected observatory of the BIOTA Southern Africa transect

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This soil scientific project forms part of the interdisciplinary BIOTA Southern Africa Project which is one of three regional BIOTA projects (BIOTA West-Africa, BIOTA East-Africa, BIOTA Southern Africa) funded by the BMBF (**BIO**diversity Monitoring **T**ransect **A**nalyses in Africa) (www.biota-africa.de). The approach of BIOTA Southern Africa is based on a macro transect stretching from north to south through Namibia and South Africa while covering the major biomes of the subcontinent. With the instalment of a long-term monitoring on Biodiversity Observatories of 1km² in size in each of the major biomes, the causes, changes and dynamic of biodiversity is to be analysed in relation to its dependency on climate and land use.

Within the BIOTA Southern Africa project this soil science subproject focuses on the soil as one important environmental factor strongly interrelated with biodiversity. Our approach follows the general hypothesis that within a given area a higher variability of abiotic factors will cause an increase of biodiversity. Depending on the applied scale and the group of organism to be analysed, the importance of the abiotic properties will vary. The various edaphic properties not only influence biodiversity but can themselves be altered by parts of the organismic world (e.g. fertile islands, round spots).

Main aim of this subproject is the description and analyses of the variability of selected abiotic properties on the Biodiversity Observatories along the macro transect. For this, our subproject designed a special sampling procedure with which the importance of the abiotic parameters for the occurrence of various organisms and the biodiversity itself can be analysed. The sampling within the observatories follows a project-wide defined scheme of a stratified, systematic and random selection of sampling areas and uses a ranking to determine the order of documentation. By this, an aggregation of the different project disciplines on selected plots is ensured. This enables a comprehensive analysis of the interrelations of various parameters of biodiversity. Per Observatory 15-40 soil profiles were implemented, documented and soil samples were taken for laboratory analyses.

Results indicate that already on the broad scale of the World Reference Base for Soil Resources (FAO 1998) the variability of soil properties on the macro transect as well as within the 1km² Observatories becomes obvious. The sampling areas of 1km² and the sampling size are suitable to represent the regional occurring main soil types. The close relationship between the soil properties and the composition of the vegetation are well reflected on the sampled plots and shall be discussed for the observatory "Toggekry" which is situated on a game farm in the Thornbush Savanna north of Windhoek/Namibia.

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Rock outcrops in India: a hitherto neglected ecosystem

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Rock outcrops form a prominent landform in Indian landscape and are important sites for specialized azonal plant communities. However, these habitats and associated plant and animal communities have so far not been described scientifically.
Most prominent rock outcrops in India are:

1. **Lateritic plateaus** consisting of duricrusts that act as caprocks to escarpments and mesas form flat and freely exposed pavements in western India in high rainfall areas.
2. **Cliffs** form a distinct feature in all the hilly areas of India e.g. in the Western Ghats. Marine cliffs occur along beaches on western and eastern coasts.
3. **Inselbergs** of granite or gneiss form old landscape features that are widespread throughout the south of India (Karnataka, Tamilnadu and Andhra) and also in Bihar. Different geomorphological forms of inselbergs e.g. monoliths, shield-like, koppje occur throughout India.
4. **Outcrops of basalt, limestone, sandstone** and **quartzite** in various formations are locally common in certain parts of India.

A first survey of the vegetation of rock outcrops in southern India revealed their rich floristic diversity and high endemism in certain regions. Many rock outcrops are sites of cultural, religious and social importance.
At present most outcrops are severely threatened by anthropogenic activities such as uncontrolled grazing, tourism and mining. Owing to the ignorance of their biological importance, there are so far no specific policies for conservation. Setting priorities for future research and conservation of these neglected ecosystems is urgently needed.

First application of palm oil baits in South America in order to attract hypogaeic army ants (Formicidae, Ecitoninae)

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The diversity and biology of the hypogaeic ant fauna has been poorly studied in the tropics mainly due to methodological difficulties. As part of the research activities of the SHIFT Project ENV 52-2 near Manaus, Brazil, we studied for the first time the baiting effect of palm oil (Weissflog et al. 2000; Insectes sociaux. 47: 317-324.) for neotropical subterraneous army ants (Ecitoninae).
We utilised the palm oil baits (80 ml oil from *Elaeis guineensis*) in eight different (sub)- habitats: two different primary forest areas, two secondary forests of different age, cultivated areas with coconut palms (*Cocos nucifera*) and the legume *Pueraria phaselioides* as part of a polyculture, and monocultures of the Peach Palm (*Bactris gasipaes*) and the rubber tree (*Hevea brasiliensis*), respectively. In total, we used 80 plots with three sampling points, each, consisting of two palm oil baited points and one control point without bait. Sampling points had a mutual distance of about 1.5 m, the sampling plots within a habitat a minimum of 40 m. The first sample of each plot was collected one day after exposing the oil bait, the second one after seven days. Altogether, 240 soil dises, 15 cm thick and 21 cm in diameter, were taken with a cylindrical soil core sampler and exposed in Berlese funnels to extract the macrofauna.

Only four species of Ecitonine army ants were found at the baits: *Labidus coecus*, *Labidus praedator*, *Neivamyrmex punctaticeps* and an undetermined, possibly undescribed *Neivamyrmex* species that reached the maximum number of individuals (6697) in all soil samples investigated. Army ants occupied 25 of the sampling points baited with palm oil with more than 10 individuals (16%; n = 160). At the control points without palm oil they could be encountered only once with more than 10 individuals (1%; n = 80). This difference is highly significant (2-tailed Fisher's test; $p<0.001$). The difference in terms of individuals is even more impressive: 56384 (99.9%) army ant workers were registered from the baited samples, only 38 (0.1%) from the control samples. One day after exposing the palm oil 7 baits (9 %) were occupied by Ecitoninae, 18 (22.5%) after seven days ($p<0.05$). Significant differences in the frequency of attracted army ants could be detected between the *Pueraria* plots and the old secondary forest ($p<0.05$), between the *Pueraria* plots and all other plots with trees ($p<0.01$), and between forests (primary and secondary) and agroforest plots ($p<0.05$).

Conclusions:

1. Palm oil baits are suitable to attract hypogaeic army ant species effectively.
2. Possibly, only less specialised, "omnivorous" army ant species are attracted, not species completely specialised on other social insects as prey.
3. Longer exposition of the baits results in a significant higher number of occupied baits.
4. The sampled army ant species seem to be more frequent in the cultivated habitats especially in the "open" plots with *Pueraria* than in the forest habitats. So far we have no explanation for this observation.

The ECOMAN Project: Decision Support System For Sustainable Ecosystem Management In Atlantic Rain Forest Rural Areas

C. Rohsius, D. J. Ballhorn, R. Lieberei

The ECOMAN project (Decision Support System for Sustainable ECOsystem MANagement in Atlantic Rain Forest Rural Areas) is a 3-year program supported by the European Commission. The objective of ECOMAN is to produce a management oriented decision support system on interdisciplinary basis to promote a sustainable development of rural areas situated in the tropical rain forests affected by intensive and growing human pressures. Three main scientific objectives build the basis for the project:

- to analyse the socio-economic and institutional driving forces that produce land use changes, to identify policies and measures to improve the socio-economic conditions by the use and protection of natural resources.
- to evaluate the intensity of use of biotic and abiotic natural resources, assessing the ecosystems resilience by using relevant key indicators.
- to produce an integrated decision support system, involving the decision-makers and stakeholders, capable to simulate scenarios on anthropogenic pressures and ecosytem changes.

The project is being carried out by a Consortium of five European Partners (Universidade Atlântica, Portugal; Joanneum Research, Austria; Universidad Complutense de Madrid, Spain; University of Trieste, Italy; University of Hamburg) and two Latin American Institutions (Fundação Pau Brasil, Brazil, and Centro Agronómico Tropical de Investigación y Enseñanza (CATIE), Costa Rica).

Two exemplary areas were defined to conduct the fieldwork: the rio cachoeira Basin in Brazil and the Central Mountain Conservation Area in Costa Rica both containing tropical rainforest. These forests face many different pressures resulting from human activities.

Within the Consortium the interdisciplinary research work is divided into different working packages covering the following issues: Land use- and Land cover; Policy Analysis; Socio-economic Analyses; Analysis of Vegetation System; Geosystem Analysis; Erosion Evaluation and Landscape Modelling; Hydrology Runoff; Biotic Resources and Adaptation of their use; Scenario Simulation; Hypothesis Testing and Validation.

The interaction of these working packages will be demonstrated within the poster. A special focus will be given for the working package Biotic resources and Adaptation of their use.

Raumzeitliche Dynamik atmosphärischer Wasser- und Nährstoffeinträge im tropischen Bergregenwald

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Im Rahmen des Forschungsprogramms ""Funktionalität in einem tropischen Bergregenwald: Diversität, dynamische Prozesse und Nutzungspotentiale unter ökosystemaren Gesichtspunkten" wird seit einem Jahr die räumliche und zeitliche Variabilität von Niederschlägen und Nährstoffeinträgen untersucht. Erstmalig in tropischen Bergregenwäldern kommt dafür ein Niederschlagsradar zur Verwendung. Weiterhin wird mit einem dichten Stationsmessnetz der Höhengradient von Nebeleinträgen sowie der chemischen Komponenten der verschiedenen Niederschlagsarten bestimmt. Diese Messungen sollen in einem integrierten Modell zur raumzeitlichen Dynamik von Niederschlags- und Nährstoffeinträgen Informationen für die verschiedenen ökologischen Arbeitsgruppen im Untersuchungsgebiet liefern. Außerdem können aus dem Untersuchungsaufbau erstmals wichtige Daten zur Niederschlagsgenese in der Andenostabdachung ermittelt werden. Herkömmliche Niederschlagsmessungen können wegen der geringen Dichte des Messnetzes die hohe räumliche Variabilität nicht erfassen. Nebel bleibt in der hydrologischen Bilanz meist gänzlich unberücksichtigt.

Das Arbeitsgebiet der ECSF (Estacion Cientifica San Francisco) liegt am Nordrand des Podocarpus-Nationalparks und reicht von 1800 bis 3200 m Höhe. Erste Ergebnisse zeigen, dass die Niederschlagsverteilung erheblich variabler und weit stärker an orographische Merkmale gekoppelt ist, als bisher bekannt war. Wesentlich ist dabei vor allem die gesamte topographische Situation. So treten Niederschlagsmaxima besonders an den exponierten Bergzügen im Ostteil des Untersuchungsraumes auf, während die hohen Bergkämme des Andenhauptkammes bereits geringere Regenmengen erhalten. Die überragende Rolle des Wasserdampftransportes aus dem Amazonastiefland wird damit deutlich.

Das Arbeitsgebiet umfasst beide Kondensationsniveaus, die zwischen 1500-2000 m und 2500-3500 m liegen. Es werden daher erhebliche Niederschlagsmengen auch über Nebel und aufliegende Bewölkung eingetragen. Bisher konnte ein atmosphärisches Nebelwasserangebot von 5 – 35% des konventionell gemessenen Regenniederschlags bestimmt werden. Dabei ist, wie beim Regen, ein deutlicher Höhengradient erkennbar. Um den Beitrag zur Wasserbilanz zu bestimmen, werden vegetationsstrukturelle Merkmale erfasst. Damit kann die Auskämmungseffizienz der verschiedenen Vegetationseinheiten ermittelt werden. Sämtliche Niederschlagsmessungen werden hinsichtlich ihrer wichtigsten Inhaltsstoffe untersucht um daraus räumliche Gradienten sowie zeitliche Trends des Eintrags von Nährstoffen in das Ökosystem Bergregenwald zu bestimmen. Im Zusammenhang mit zunehmender Brandrodungsaktivität, sowie vulkanischen Ereignissen sind interessante Beiträge zum Nährstoffhaushalt zu erwarten. Ergebnisse dieser Messungen werden an Arbeiten anderer Gruppen im Gebiet gekoppelt um zu einer umfassenden Nährstoffbilanz zu gelangen.

MHC variability and parasite resistance in a small lemur in the littoral forest fragments of southeastern Madagascar

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Increasing habitat fragmentation has focused attention on the impact of increased subdivision on population genetics which quite often results in a loss of genetic diversity due to genetic drift and inbreeding with negative effects on fitness parameters. In vertebrates growing evidence suggests that such genetic diversity is particularly important at the level of the major histocompatibility complex (MHC) because its gene products play an important role in immune functions. Loss of variability could affect the vulnerability to parasites and pathogens by two different ways, either directly by a reduced number of heterozygous MHC loci and therefore a decreased effectiveness in dealing with a wide variety of pathogens, or indirectly as a result of the greater fitness of outbred individuals that are heterozygous across much of their genomes, including their MHC loci.

In this study, we used the endemic lemur *Microcebus murinus* in the highly fragmented littoral forest of southeastern Madagascar as an example to test for the negative correlation between parasitism and genetic diversity. We analysed the proportion and intensity of infected individuals by trematodes, cestodes and nematodes with respect to fragmentation and population size. The genetic variability was investigated in the functionally important MHC gene DRB exon 2.

Intraspecific spatial seggregation in male Afrotropical treefrogs (Hyperolius)

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In western Kenyan rainforests, the treefrog *Hyperolius* cf. *cinnamomeoventris* (Bocage) displays a prolonged breeding strategy. During several months of the rainy season, males aggregate at ponds and acoustically advertise for gravid females. If calling males compete for space, we may hypothesised that favourable calling sites exist, resulting in an uneven distribution of male relative fitness over a spawning site. Relative fitness of individual males was defined by a body condition index (calculated from snout-vent-length and weight). However, male fitness was neither correlated with their horizontal (as defined by 10 random pond segments of equal size and by the distance from the ponds midpoint) nor with their vertical (as defined by height above ground) distribution. This may indicate that males randomly distribute around a pond with no competition for prefered calling sites.

Libellen temporärer Wüstengewässer: Risikostreuung bei der Kolonisation

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Prioritätseffekte und Konkurrenzausschluss durch schnelle Entwicklung sind entscheidende Komponenten für den Fortpflanzungserfolg in ephemeren und temporären Gewässern in Wüsten. Die Libellen am Rand der Namib-Wüste bestehen aus im Gebiet überdauernden Formen (Residenten) und solchen, die durch ausgeprägte Migration gekennzeichnet sind. Beide Typen unterscheiden sich u.a. deutlich im Dispersionsmuster während der Eiablage. Migranten wie *Pantala flavescens* und *Sympetrum fonscolombii* tendieren deutlich dazu, ihre Eier über mehrere Gewässer zu verteilen. Vertreter der Residenten, wie *Orthetrum chrysostigma* oder *Trithemis kirbyi*, konzentrieren die Eier hingegen auf ein Gewässer bzw. einen Gewässerbereich.
Wenn Eier weiträumig verteilt werden, so sollten stets – über die gesamte Eiablage eines Weibchens- solche dabei sein, die Konkurrenzvorteile bieten. Bei lokaler Konzentration ist hingegen zu erwarten, dass ein Weibchen besonders in die Qualität der ersten Eier investiert. Weibchen wurden direkt nach der Kopulation sowie vor der Eiablage gefangen und ihre austretenden Eier im Rhythmus ihrer artspezifischen Ablagebewegungen auf verschiedene Behälter verteilt. Als Parameter der Qualität der Eier wurde die Eigröße, E-Entwicklungs- geschwindigkeit und Größe des ersten Larvenstadiums herangezogen. Dabei ließen sich zwischen den Migranten und den Residenten nicht nur verschiedene Eiablageverhalten aufzeigen, sondern die verschiedene Eigrößen-, Entwicklungsgeschwindigkeits- und Larvengrößenmuster über die Gelege deuteten auf verschiedene Risikostreuungsmuster hin.

Decline of moth diversity at the upper forest belt of Mt. Kilimanjaro as a result of fire

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Species composition and diversity of nocturnal geometrid moths (Lepidoptera: Geometridae) was investigated on nine plots located in the Mt. Kilimanjaro National Park, Tanzania. Four plots were situated within the closed montane forest at 2700 and 2900 m, two others in forest fragments at 3100 m, and three plots were established in ericaceous shrub land at 3100 and 3300 m. Moths were attracted between 19:00 and 22:00 local time using a light tower (height: 1.7 m, diameter: 0.8m) with a 15W black light tube and sampled manually. Geometrid moths were chosen as they are among the most numerous insect groups in the study area and proved to be suitable indicator organisms in a number of similar studies.

The upper forest border on the SW-slopes of Mt. Kilimanjaro is currently positioned much lower than the potential natural forest border. This must be considered as a result of anthropogenic fires which regularly occur in recent times. The forest border was hence pushed downwards and the forest replaced by ericaceous shrub land, while small isolated fragments of forest remained in some moist areas.

The overall alpha diversity of the geometrid moth communities in the study area was very low (Fisher's α: 5-15) compared to other tropical montane forests. Alpha diversity in the forest fragments was comparable with the closed forest (Fisher's α: 12-15), while it was significantly lower (Fisher's α: 4-8) in the ericaceous shrub land.

Species composition of geometrid moth ensembles differed strongly between closed forest and heath shrub land, with communities from forest fragments being intermediate. This pronounced change was most obvious through a near - complete lack of typical forest species above the upper forest belt.

Forest fragments therefore cannot be considered as refuge habitats for most geometrid forest species as their communities are strongly influenced by the surrounding ericaceous shrub land communities.

An increase of extreme climatic conditions leading to shorter intervals of fire occurrences in the future might therefore have a dramatic effect on the insects bound to the specific moist and more stable microclimatic conditions within the upper montane closed forest.

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The West Africa Collections in the Herbarium Senckenbergianum (FR) and the Ouagadougou University Herbarium

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Since the 1960s West Africa has been a special field of interest for botanists at FR. A separate collection of specimens from West Africa was built up since 1988 in the course of an interdisciplinary research project (SFB 268 "Westafrikanische Savanne"). These collections – principally from Burkina Faso, Benin and Nigeria - comprise app. 10.000 specimens, of which 8.000 are digitalized in a BRAHMS database, thus providing an important data source for this undercollected region.

These specimen-based data are analysed as follows:
1. Collecting densities for Burkina Faso as an important foundation for further collecting activities in this country.
2. Distribution areas of indicator species and their variation in time
3. Specimen-based data as a link and validation for large-scale biodiversity maps (cooperation with BIOTA W03, see also poster W. Küper et al. this congress). Our data fit very well to close gaps in distribution data from West Africa.

Recently, BIOTA W03 and W11 have started to develop a joint program for retrieval of collection data via internet.

Maps of collecting densities (phanerogams) and distribution areas of Poaceae obtained from the specimen database are presented for Burkina Faso and consequences for the development of the Ouagadougou University Herbarium and the use of grasses as indicators are discussed.

Can Grasses (Poaceae) serve as indicators for Phytodiversity?

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Ethnobotanical studies in Burkina Faso and Benin revealed a high sensitiveness in local pastoralists and agriculturists for changes in flora and vegetation. Their perception/assessment of pastoral or agricultural value seems to be well based on selected species or species groups. Especially for the estimation of soil fertility, the presence/absence of various grass species appears to be crucial.

Based on local expertise and field studies the species inventory and dominance of Poaceae were investigated in selected plots of roughly defined human impact (cattle grazing, agriculture, game reserve) in order to allow a more rapid vegetation assessment. Field studies were performed in Burkina Faso and Benin and over 1500 relevés from BIOTA W11 and SFB 268 were analysed.

Phytodiversity expressed by species numbers as well as diversity indices is presented for plots in Sahel and northern Sudan zone and compared to diversity of grasses as "indicators" alone. Abundance/Dominance of perennial vs. .annual grasses provides better information about the impact of grazing than species richness/species dominance alone.
Further potential "indicator groups" (woody plants, geophytes) are discussed.

Dendrochronological Investigations on Tropical West African Tree Species and their Potential for Climate Reconstruction

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Since the early 1970ths tropical West Africa has suffered from a prolonged drought. Variations in the sea surface temperatures of the global oceans are generally considered to be a major cause of interannual to multidecadal rainfall variability across tropical West Africa. However, the existing instrumental meteorological records are not long enough to provide multiple realisations of the decadal variability of precipitation patterns in this region. Dendrochronology – the dating of past events using tree rings – is a valuable tool for climate reconstruction. In the tropics these studies are not widely applied due to the assumption that tropical trees do not form annual growth rings, because there is a lack of a strong seasonality in temperature which triggers the growth rhythm of trees in temperate zones. Annual rings have, however, been recorded in many tropical regions with a strong seasonality of precipitation. It was predicted that (1) most of the West African tree species investigated would show annual tree rings, (2) variation of rainfall patterns from year to year is reflected in ring-width patterns and (3) the reconstruction of past climate conditions is possible.

The study sites are the Ouémé catchment area in Benin and the Comoé Natioal-Park of the Ivory coast (~10° N), both characterised by a severe dry season of 6-8 month per year (October-June) with monthly rainfalls less than 50 mm. From a total of about 200 trees comprising the species *Afzelia africana*, *Daniella oliveri*, *Isoberlinia doka*, *Pterocarpus erinaceus* (all Fabaceae), *Diospyros abyssinica* (Ebenaceae) and *Anogeissus leiocarpus* (Combretaceae) two cores per individual were sampled. The wood samples were prepared, growth zone structures were analysed and the ring-width was measured to the nearest 0.01 mm using a LINTAB measuring device. Standard dendrochronological techniques ("Gleichläufigkeit", *T*-Values) were used to cross-date the time series of wide and narrow rings among individuals of one tree species at each study site. Successfully cross-dated ring-width series of different individuals were averaged to built a mean chronology. For climate-growth relations the raw ring-width curves were indexed using a 5 yr moving average to remove long-term growth trends. Monthly rainfall totals have been averaged for 5-6 climate stations at each study site comprising the period between 1922-2001 (Benin) and 1921-1990 (Ivory coast).

For all species ring-width correlates significantly with the amount of precipitation during the rainy season of the corresponding year which documents the existence of annual tree rings. The climate-growth relations is useful for dendroclimatic reconstruction of the past climate in tropical West Africa. *Afzelia africana* and especially *Daniella oliveri* have a high potential for dendroclimatic studies due to the distinctness of the annual rings and the high ages of these tree species. This allows us to built up chronologies to highlight the decadal variability of rainfall patterns for the last 200-300 years. We are optimistic that future investigations will provide a valuable network of precipitation-sensitive tree-ring chronologies covering a large area of tropical West Africal. These dendroclimatic proxies are useful for the reconstruction of past precipitation and eventually the impact of major climate events such as the El Niño-Southern Oscillation.

Savannah islands in the rainforest, amphibian and dragonflies on inselbergs of Taï National Park, Côte d'Ivoire.

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We investigated amphibian and dragonfly assemblages on 15 granite shield inselbergs in Taï National Park, Côte d'Ivoire. These old rocky outcrops (several 100,000 years old) represent extrazonal ecosystems that are surrounded by lowland rain forest. They provide arid gaps with savannah like conditions, in otherwise closed-canopy forest. The inselbergs varied in regard to surface (0.5 ha to > 1 km²), degree and structure of vegetation cover, and number, size and structure of temporary waters. Some 3,500-10,000 years ago, when only small rain forest relicts persisted in West Africa, the Taï inselbergs were most probably surrounded by savannah. Today, the inselberg fauna is made up by species occurring in the surrounding forests, and degraded forest habitats, and by true savannah species. We have been investigating amphibian and dragonfly assemblages, representing animals with a potentially low and a potentially high dispersal capacity. We analysed how habitat structure, size and isolation of different inselbergs influences amphibian and dragonfly community composition. Further, we tried to figure out if the presence of true savannah species in both taxonomic groups might be best explained by a relict hypothesis or by continuous colonisation events. First results support the latter theory.

Neotropical rain forest classification and biomass upscaling with the new multi-spectral Sensor ASTER

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Closed canopy rain forests typically cover landscapes with varying edaphic conditions. Small scale disturbance introduces additional vegetation heterogeneity. Affordable optical space-borne imagery was up to now limited to sensors with a ground resolution of 30 m or above. Such resolution may not pick up subtle class boundaries in e.g. highly dissected hill regions as well as floodplain with small secondary vegetation stretches along oxbows and creeks.
The new multispectral spaceborne sensor ASTER was introduced by NASA in December 1999. It features a spatial resolution of 15 m in the visible range, additional infrared bands (11 bands) and a stereoscopic imaging capability.
We explored the classification capabilities using ASTER imagery compared with common multispectral sensors, such as LANDSAT-TM, for a neotropical rain forest area in the South-East of Peru. The study area covers the middle stretch of the Manu River, a meandering white water river. The landscape there includes a floodplain with oxbow lakes and eroded alluvial mesas forming hill areas with a vertical topographic variation of less than hundred meters. River disturbance, slope erosion, pronounced differences in soil water availability and varying soil nutrient status causes a mosaic of structurally very different vegetation types with their biomass stocks varying from less than ten up to more than one thousand tons biomass per hectare.
One goal was to improve vegetation class detectability and accuracy in highly variable forest types. It was assumed, that higher spectral resolution will result in both, more information categories and in an improvement of class separability. A second goal was to study the effect of the higher spatial resolution of ASTER in three bands. This should allow the classification of objects within an horizontal extend of at least 15 m. This resolution is twice as high as LANDSAT-TM and reaches the size of very large individual tree canopies. A third goal was to use the ASTER stereoscopic capability for Digital Elevation Model (DEM) creation in order to eliminate radiometric distortions due to topographic slope effects e.g. in the hill areas.
Based on the vegetation classification and biometric ground truth measurements in large plots, a full aboveground biomass estimation for the landscape was made.

Differential response of diplopods to litter quality and impact on nutrient cycling in central Amazonia

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The importance of macrofauna in determining decomposition and nutrient release patterns in the tropics has been shown in various studies, but the ecological characteristics of single species have rarely been elucidated. A new approach of microcosm experiment has been developed to study the interaction of diplopods with microbes in decomposition of seven major leaf litter types occurring in a central Amazonian agroforest. Three different diplopod species were incubated with litter marked by 15N enrichment in integrated microcosms along with microfauna/-flora only and soil only control. Leachate water was collected continuously and pooled after 45 days when replicates were terminated by destructive sampling. Terminal C, N and 15N contents were measured in water and animals, and initial values also for litter and soil. Litter was analysed additionally for polyphenol content.
With exceptions, the PP/N ratio was a good estimator of litter mass loss. There was a significantly higher decomposition under animal influence in good and medium quality litter. Nitrogen release did not correspond to carbon loss from litter, but was also increased by the diplopods in good quality litter. There were marked differences between animal species in the impact on decomposition: The pantropical *Leptogoniulus sorornus* led to more than twice the loss in carbon per gram body weight than the indigenous *Pycnotropis sigma*. Additionally, the effect depended upon litter quality. *Leptogoniulus sorornus* was more tolerant to polyphenol, and was the only species attacking *Bertholletia excelsa* litter, while the third species, a yet unidentified Rhinocricidae, showed an especially high impact on *Bixa orellana* litter, producing a layer of stable humus on the soil surface, without increasing nitrogen leaching. During the experiment, nitrogen release increased with time, with no differences between treatments.
The species used were dominant in number in different vegetation structures (*Pycnotropis* and the third species) and different localities (*Leptogoniulus*). We argue that nutrient cycling through litter decomposition can be significantly influenced by the activity of macrofauna, depending on litter composition and microclimate. Zoological composition of the macrofaunal community might have an influence on decomposition. Colonisation of litter resources by different species might depend upon specific disposition to handle polyphenols and microclimatic constraints.

Effect of altitude on the ability of fine roots for nutrient acquisition in South Ecuadorian montane forests

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The ability of plants for nutrient acquisition is dependent not only on physiological root characteristics but also on the exploitation of the soil by roots, and on morphological root characteristics such as root diameter, that determine nutrient flux rates in soil to the root surface. Root growth and diameter are affected by chemical soil characteristics, e.g. soil pH and availability of plant nutrients, and by physical soil characteristics, e.g. water content and temperature. It may be expected that these soil characteristics vary with increasing altitude of forest sites. In this project, root length density (RLD) and mean root diameter were compared in South Ecuadorian tropical montane forests at altitudes of 1900 m, 2400 m and 3100 m a.s.l.. Soil cores were sampled at different soil depths (organic surface layer, 0-10 cm, 10-30 cm, 30-50 cm, 50-70 cm, 70-90 cm and 90-110 cm). The fine roots (diameter < 5 mm) inside the cores were collected, and length and morphological characteristics of living roots were measured using an image analysis system (WinRhizo).
The specific root length was higher at 1900 m (12.5 m g^{-1} root DW) than at 2400 m and 3100 m a.s.l. (6.4 and 7.8 m g^{-1} root DW, respectively). Mean root diameter decreased with increasing depths of mineral soil layers, but was only little affected by the altitude of the forest sites. Total root length per surface area was not markedly affected by the altitude. However, with increasing altitude the roots were more concentrated in the organic surface layers. At 2400 m a.s.l. 66% and at 3100 m a.s.l. 76% of total fine root length was confined to the organic surface layers, whereas at 1900 m only 51% of the fine roots were growing in this layer. Furthermore, at high altitudes, RLD in the mineral soil decreased more strongly with increasing soil depths. At 2400 and 3100 m a.s.l., RLD decreased to values lower than 0.5 cm cm^{-3} already at soil depths below 10 cm, indicating that root density may become limiting for complete capture of soil resources with low mobility in the mineral soil. In contrast, at 1900 m a.s.l, RLD remained larger than 0.5 cm cm^{-3} even at soil depths below 70 cm. Soil chemical data indicate that low exploitation of mineral soil layers by roots at 2400 and 3100 m a.s.l. was associated with extremely low pH.

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Plant diversity extrapolation in tropical countries: The model BIOM and its application in Bolivia

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Habitat destruction and species extinction in tropical countries is advancing more rapidly than biodiversity inventory. Thus, conservation planning and action cannot wait until a substantial improvement of the current state of knowledge. With BIOM (BIOdiversity extrapolation Model) we introduce a diversity prediction model on regional to continental scale. It allows an assessment of spatial biodiversity patterns and individual species ranges supporting conservation priority setting. The grid-based model calculates habitat suitability for single species. Correspondence to abiotic gradients at known collection sites is calculated by a normal distribution algorithm for all grids within the study area. Analogous to the Law of the minimum of Liebig we argue that habitat suitability corresponds to the abiotic parameter least fitting to the species habitat requirements. Thus, the potential range is determined by appropriate abiotic parameters. The realized range, however, contains those parts of the potential range that are situated within the wider vicinity of collection sites and the centre of distribution.
Diversity patterns are illustrated, using a Geographic Information System (ArcView 3.2), by an overlay of the approximated ranges of various species and calculating species richness and endemism indices per grid cell. We show extrapolated maps for a selection of plant species within Bolivia at a resolution of 2*2 Arc minutes. A quality evaluation is carried out by using the receiver-operating-characteristics technique.

IMPETUS: An Integrated Approach to the Efficient Management of Scarce Water Resources in West Africa

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In the IMPETUS project thorough investigations of all aspects of the hydrological cycle are carried out within two river catchments in North West and West Africa: the wadi Drâa in the south east of Morocco and the river Ouémé in Benin. This choice is motivated by the possibility that the climates of Africa and Europe interact through atmospheric teleconnections, and evidence that since the 1970s the droughts north and south of the Sahara have probably been related.

Project A: The hydrological cycle of the Ouémé catchment and socio-economic implications
Since the early 1970s Tropical West Africa has suffered from a prolonged drought that reached its first climax in the first half of the 80s. All climatic zones, from the semi-arid Sahel and the sub-humid Sudanese zone down to the humid Gulf of Guinea, have been affected. These rainfall deficits have brought about a profound deterioration in the economic and social development of the West African countries, among which is also Benin.
A hierarchy of nested meteorological and hydrological models have been developed to assess the effects of environmental and anthropogenic change on the hydrological cycle and to analyse likely 'future scenarios'. Dramatic land use and land cover changes were already detected at a number of 'hot spots' for the last 20 years by remote sensing. Migration into the study area takes place in an institutional vacuum and without governmental support. The consequences are transformations of socio-economic structures on the local scale and changes in land use patterns. A close co-operation of the anthropological and medical sciences provides a basis for the detection of communal 'hazards' influencing the water system with respect to quantity and quality, the local perceptions of these dangers and the role of local risk minimising strategies.

Project B: Water-balance of the Drâa catchment area and socio-economic implications
Since the late 1970s, Morocco has experienced a number of extremely dry winter seasons, the causes of which are not fully understood. They are assumed to be related to changes of the large scale circulation on interannual and interdecadal time scales as manifested in the North Atlantic Oscillation or the El Niño-Southern Oscillation. Against this background, the development of sustainable water resource management is a strong necessity.
In order to address a number of imminent problems limiting the availability and allocation of water along the wadi Drâa 11 measurement sites were installed along a gradient of elevation and aridity. Monitoring of the thickness and the extent of the snow cover in the High Atlas mountains is essential to enable the competing water users (power generation, irrigation, domestic consumption) to have adequate supplies. In addition to seeking a better understanding and prediction of the geospheric, atmospheric, and biospheric components of the hydrological cycle, the IMPETUS activities centre around the questions of the influence, risks and resulting conflicts of human activities in the context of the specific social and economical structures encountered in the area.

Biodiversity of Namibian dragonflies: dynamic processes in communities

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The community is a relevant unit for biodiversity. To identify such communities we studied dragonfly assemblages in the Namibian deserts by recording species at about 300 sites, which represent almost all types of surface waters. We identified four major groups of habitats, which differ in their dragonfly similar assemblages and are sorted along a habitat permanence gradient. Temporary wetlands are the most common type of habitats.

Temporary ponds in the Namibian semi-desert may be visited by a large number of dragonfly species even if the ponds are widely isolated from other aquatic habitats. At artificial ponds we identified 26 species, of which, however, only some colonised the ponds, i.e. laying eggs. The colonisers can be separated into two major groups. Group 1 consists of residents in the area, such as *Trithemis kirbyi* or are facultative migrants entering the area in small numbers, e.g. *Crocothemis erythraea* and *Orthetrum chrysostigma*. Species of group 2 are obligate migrants, which perform often long distance dispersal, normally in large aggregations, as obligate part of their life cycle, e.g. *Pantala flavescens* and *Sympetrum fonscolombii*. During two consecutive years almost exclusively migrants emerged successfully from our artificial ponds. Studies with early stadium larvae revealed that larvae of the migrants (group 2) are more active and have higher food intake than larvae of group 1; consequently the initial growth of the migrants was faster. This difference may make the migrants the superior competitors, which is supported by results from a two-species interaction experiment with *S. fonscolombii* and *T. kirbyi*, in which *T. kirbyi* became almost extinct. However, the interaction between migrants and residents may be altered by temporal differences in colonisation, i.e. temporal priority. We found that *T. kirbyi* survives and even dominates the competitive superior *S. fonscolombii* when the latter was introduced to the system much later than *T. kirbyi*. Because colonisation patterns vary widely between different years priority appears to be a relevant factor for the assemblage.

Is there a connection between the patchy distribution pattern of myco-heterotrophic plants and the composition of the soil?

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Most myco-hetrotrophic plants (Ericales and Orchidaceae excluded) occur in damp and shady places in tropical rain forests. They show a distinct patchy distribution pattern, each patch comprising individuals of different genera and even families which often coexist on only a few square meters. This observation was made by many authors in many different places of the world.

In tropical Africa this phenomenon was first described by Rudolf Schlechter in 1906, who reported of five different species coexisting on the same spot.

Within the scope of a BIOLOG-financed project, an attempt is being made to explain this phenomenon by taking into account the vegetation structure, the involved mycorrhizal fungi and the chemical soil composition.

The study presented here was carried out in the Bimbia-Bonadikombo Community Forest (also known as prop. Mabeta-Moliwe FR) being located in Cameroon's Southwest Province. The area is a costal rain forest situated on old volcanic rocks, exposed to high rainfall precipitation (5000 mm/a).

Four 10 x 10 m plots were established. Three plots comprised populations of myco-heterotrophic plants. One plot without myco-heterotrophic plants was used as a control. Soil samples of each plot were taken and the chemical composition was examined in the laboratory. The results were compared to each other and linked with the vegetation structure and the presence of myco-heterotrophic plants.

Crowding of tadpoles in temporary ponds? – A study of an Afrotropical anuran

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It is suggested that crowding effects anuran larval growth: the more limited the resources are (e.g. water volume, food), the more limited are growth rate and size of metamorphs. Some individuals may pass crowding and hence develop an advantage. Crowding seems to affect mainly species that reproduce in small water bodies such as puddles and/or that show an explosive breeding strategy. It guarantees that at least some individuals survive periods of resource limitation.
We experimentally studied crowding in an Afrotropical ranid frog, *Ptychadena oxyrhynchus* (Smith) in humid western Kenya (Kakamega Forest), where it breeds in puddles. Growth of 15 freshly hatched tadpoles each from a single egg clutch was monitored for 40 days in four different volumes (0.5, 1.0, 4.0 and 8.0 l, respectively; five replicates each). Tadpole growth did not significantly differ among treatments for 30 days. Subsequently, relative growth rate drastically decreased in all volumes except the largest. Hence we conclude that crowding evolved in *Ptychadena oxyrhynchus* as an adaptation to puddle breeding.

Structural and species diversity in the southern Kalahari: the impact of land use and climatic change

Jörg Tews, Monika Schwager, Matthias Wichmann, Niels Blaum, Karl-Heinz Müller & Florian Jeltsch

According to a basic definition of 'biodiversity' (UNEP 1992) biological diversity means the variability among living organisms and the ecological complexes of which they are part. This not only includes species diversity but also the diversity of ecological structures or 'structural diversity'. Structural diversity encompasses both functional structures such as food webs and spatial structures, i.e. landscape structures at different scales. Both elements of biodiversity - species and structural diversity - are closely interlinked. Any changes in habitat structures imply the risk of species loss. However, we are far away from a functional understanding of this interrelationship.

BIOTA Subproject S09 uses an interdisciplinary approach, combining field and modelling studies, to get an improved understanding of the complex impact of the dynamics of landscape structures on species diversity under the major driving forces, i.e. land use and climatic change in the southern Kalahari. First results emphasize the strong impact of climate change and land use on species diversity, both directly and via changes in structural diversity as formed by woody vegetation.

Linking structural with species diversity - model based insights from interdisciplinary studies

Jörg Tews, Monika Schwager & Florian Jeltsch

According to a basic definition of 'biodiversity' (UNEP 1992) biological diversity means the viability among living organisms and the ecological complexes of which they are part. This not only includes species diversity, but also the diversity of spatial and functional structures in an ecological system, i.e. 'structural diversity'. Both structural and species diversity are strongly coupled entities that support the integrity of an ecological system. If an external pressure is applied to one component, for example a key species or a crucial ecological structure, it will likely effect each element that is directly or indirectly linked to it and, in the long run, the whole biological system. In this presentation we will summarize model based insights from a large, multidisciplinary research project situated in the southern Kalahari dry savanna (BIOTA S09 – BIOLOG). The aim of this project is an improved understanding of the complex impact of the dynamics of landscape structures on species diversity under the major driving forces, i.e. land use and climatic change. The project consists of several subprojects linked in an interdisciplinary approach, combining expertise of zoological, botanical, genetic, remote sensing and socio-economic field studies with spatial-explicit simulation models.

How cattle affect landscape structure on southern Kalahari rangelands: insights from a grid-based computer model

Jörg Tews, Frank Schurr & Florian Jeltsch

Shrub encroachment, i.e. the increase in woody plant cover, is a major concern for livestock farming and ecosystem conservation in Southern African savannas. It is usually associated with overgrazing by domestic livestock. In this study we show the impact of seed dispersal by cattle on shrub encroachment in the southern Kalahari. We developed a spatial-explicit, stochastic computer model simulating the population dynamics of *Grewia flava*, a common, fleshy-fruited shrub encroacher. In the absence of large herbivores seeds of *G. flava* are largely deposited beneath woody plants, e.g. *Acacia erioloba*. Cattle negate this dispersal limitation by browsing on the foliage and dispersing seeds into the grassland matrix. Based on the simulation results we suggest that cattle directly facilitate shrub encroachment of *G. flava*. For a high seed dispersal intensity without fire (equivalent to a high stocking rate) the model predicts an increase of shrub cover by 40 % after a grazing period of 80 years. As a management recommendation we suggest that shrub encroachment on rangelands may be countered by frequent fires and controlling cattle movements to areas with a high proportion of fruiting *Grewia* shrubs.

Kleinräumige Verteilung von Bestandesniederschlag im giuneo-kongolesischen Regenwald Kakamega, Kenia

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Within the BIOTA-framework „Biodiversity Monitoring Transect Analysis in Africa", which is part of the BMBF financed framework BIOLOG (Biodiversity and Global Change) investigations on the heterogeneity of canopy throughfall in the Kakamega forest in Kenya (East Africa) were continued. The Kakamega forest is the largest remnant of the Guineo-kongolian rain forest block in East Africa.

In 9 different plots (each 400 m² in size) in three different sites of Kakamega, 9 collectors were installed in a 5m grid. From Mai to August 2002 thirty-seven rain events were sampled. The amount of rainfall varied between 3,75 and 206 $mm \cdot m^{-2}$ in the open bed precipitation. In the same rain event the open bed precipitation often varied with a factor of 2-3 among the diffentent sites.

The amount of bulk precipitation of single rain collectors (calculated as % of open bed precipitation) varied mostly between 50-120%, but reached also in the extreme cases 4-198%.

Electrical conductivity and pH was also measured in the rainwater. Generally the pH values were around one unit higher in the canopy throughfall than in the open bed precipitation. The electrical conductivity was generally higher in the bulk precipitation by factors of 2-3.

Vegetation changes in the course of forest regeneration on Mt. Kilimanjaro, Tanzania

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Im Zuge des DFG-Projektes der Universität Bayreuth zur Regenerationsforschung am Kilimanjaro wurde im Kilimanjaro Forest Reserve zwischen 2.000 und 2.300 m ü. NN entlang der Machame-Route die Vegetation unterschiedlicher Waldregenerationsphasen aufgenommen. Insgesamt 33 Flächen von je 20m · 20m wurden untersucht. Die Erhebung von floristischen Merkmalen, die sich auf vaskuläre Pflanzen beschränkte, wurde in Anlehnung an die von Braun-Blanquet (1964) beschriebenen Methoden durchgeführt. Die statistische Auswertung erfolgte anhand von Präsenz/Absenz-Daten.

Zwei nach unterschiedlicher Höhenlage getrennte Waldtypen konnten unterschieden werden. In beiden dominiert *Ocotea usambarensis* ENGL. (afrikanischer Kampfer). Oberhalb einer Höhe von etwa 2.200 m tritt die Steineibe *Podocarpus latifolius* (THUNB.) MIRB. auf, unterhalb die Bäume *Macaranga kilimandscharica* PAX und *Myrica salicifolia* HOCHST. . Die Regeneration erfolgt typischerweise über kleine Gaps, die natürlich oder anthropogen durch Baumsturz entstehen. Im unteren Bereich treten zudem großflächige Lichtungen auf, die auf Rodung und Brand zurückgehen. Auf diesen Flächen dominiert anfangs *Pteridium aquilinum* (L.) KUHN (Adlerfarn), der sich durch wiederholte Feuer lange halten kann.

Literatur:
Braun-Blanquet, J. (1964). Pflanzensoziologie. Springer-Verlag.

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Insect folivory on nine common tree species in the West African savannah (Comoé National Park, Ivory Coast)

Sybille B. Unsicker, Karsten Mody & K. Eduard Linsenmair

Leaf chewing insects are important factors in plant population regulation because they can remove photosynthetic tissue which reduces energy gain and thus growth. This insect folivory has been widely studied in temperate and tropical forests but not in the woody plants of tropical savannahs even though this system is particularly interesting because it is climatically intermediate between temperate and wet tropical systems. We therefore measured insect folivory on trees in West African savannah at Comoé National Park, Ivory Coast. We took discrete samples of leaves from nine common shrub and tree species of five families (Combretaceae, Euphorbiaceae, Leguminosae, Monotaceae and Rubiaceae) and assessed the percentage of leaves damaged by folivorous insects and the percentage of total leaf area consumed. The number of leaves attacked was highly variable within individual plants of the same species as well as between species. Leaf area loss was also variable among the species sampled, with means ranging from 2.3% to 8.1%. The mean relative coefficient of variation for leaf area loss was highest within individuals of one species and lowest between all tree species. The generality of our results is difficult to assess because there is a lack of comparable studies but it is clear that explanations must be sought for the considerable heterogeneity in insect folivory.

Tree diversity and dispersion in a guineo-congolian forest remnant, Kakamega forest, Kenya

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Topic: Tree species composition, diversity

Within the BIOTA-framework "Biodiversity Monitoring Transect Analysis in Africa", which is part of the BMBF financed framework BIOLOG (Biodiversity and Global Change) investigations on stand structure in Kakamega forest, Kenya were started in August 2001. The influence of the human impact on tree diversity, dispersion and age distribution is analysed using different ordination methods. Research is performed within different fragments and degradation stages on 20x20m plots which are chosen randomly for statistical independency. Additionally regeneration studies are carried out and related to abiotic parameters like canopy cover and PAR. Information about biomass increment of different species is gathered by measuring diameter growth rates with dendrometers.

Biological soil crusts: composition, distribution and functional diversity

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Biological soil crusts comprise lichens, mosses, green algae, microfungi and cyanobacteria. They occur in soils of arid and semi-arid regions, which cover 30% of the earth surface. Through their impact on soil structure and physical properties, biological soil crusts adopt different ecological roles. Their relative importance is dependent on composition and biomass of the crusts and on ecosystem features. The subgroup 5 of the BIOTA project (BmBF) examines diversity, structure and function of biological soil crusts and their effects on the diversity of other organisms. The investigation takes place in observatories situated along a transect from the Cape Peninsula to northern Namibia.

First results show the presence of 23 genera of cyanobacteria, 21 taxa of green algae and several lichen species. Two main types of biological soil crusts, climax and pioneer crusts, can be determined in the field. Further types could be specified regarding the occurrence of the major taxonomic groups. All resulting data are comprised in a relational database which is available via intranet. The correlation of environmental factors with distribution patterns of soil crusts is investigated and presented by means of GIS (geographic information systems).

Time series analysis of landscape indices derived from satellite imagery as a tool in ecology: an example from the tropical savannas of northern Australia

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Human land use may have a big impact on landscape condition, this includes fragmentation and the reduction of annual primary productivity. Declines in landscape condition may in turn affect biodiversity, this effect's determined both by current land condition, and trends in condition over past years. Satellite imagery provides a potentially powerful tool to analyze the effects of various disturbance regime on land condition, and therefore on biodiversity. This is because of the large spatial coverage and the historical archive of imagery which allow analysis of change over time. The spatial structure of a landscape, features such as the amount of bare soil and vegetation cover, and the patterning of these features at different spatial scales (landscape patchiness) is likely to be important to biodiversity. The use of satellite imagery offers a broad spectrum of possibilities to analyze landscape structure. Several approaches, such as primary productivity derived from NDVI (Normalized Difference Vegetation Index); patchiness of landscape; and minimum size of patches to support viable wildlife populations have been used in recent ecological studies. In this study we investigated the relationship between land condition and biodiversity in the Victoria River District of the Northern Territory, Australia. This tropical savanna has a monsoonal climate and has been used for pastoralism for the past 100 years. Land condition in this area reflects a complex relationship between past grazing history, current grazing management and variation in seasonal rainfall, and is mostly reflected in the structure, composition and patchiness of the grassy understorey. 38 Satellite images (Landsat MSS (Multispectral Scanner) and TM (Thematic Mapper) from 1983 to 2002) were used to assess land condition in the study area. The images used cover early (before June) and late (after august) dry season of each year. The bands 3 + 4 and 2+3 TM and MSS respectively were atmospheric and sun angle corrected using invariant target analysis, his method allows comparison of actual values of the pixels and uses them to determine primary productivity. An invariant target analysis requires areas which do not change over time, and which cover the whole range of pixel values (deep water, sand, gravel road etc.). One image will be used as a reference image for correction of other images. This image should be the one least affect by aerosols or cloud cover. A regression analysis was conducted on the values of the invariant targets of each band for the reference and the raw-image band on the y and x axis respectively. The offset and gain is used for the correction of the raw image (band1_output = band1_raw * slope + intercept). The GRASS GIS (Geographic Resources Analysis Support System) was used to compute a range of landscape indices for a time series (1983-2002) to cover spatial change in landscape conditions over time. We used the Modified Soil Adjusted Vegetation Index (MSAVI) rather than the NDVI, because it seems to be more resistant to changes in soil background reflectance. On the basis of this vegetation index (VI)I we calculated mean, standard deviation, richness, Shannon Diversity Index, dominance, inverse Simpson Index, contagion, angular second moment (energy) and contrast of each pixel in a radius of 60, 120, 180, 240 and 480 meter around each pixel using

the r.le module in the GRASS GIS. The images were split into two time series, early and late dry season and the output of the GRASS GIS was used to calculate mean and standard deviation over time for each separate radius and for regression analysis of tendencies of pixel values. The same was done with the intra annual variation of primary productivity (mean of all radii) by subtracting the values for the late from the early image values.At 72 sites, ground cover measurements were taken and correlated to vegetation indices (VI's). This approach could supply more realistic landscape conditions than only non-recurring ground cover surveys because it is including time rather than only the condition at one date, and also considers the spatial variation in a landscape. Future work will include these indices for analyses of biodiversity of different species sampled in 2002. Different radiuses of these indices are important for different species. It is assumed that termites are only affected by changes of the core pixel and up to a radius to 150m, more mobile animals should be more affected by changes in a radius of 240 or 480 meters such as birds.

Vergleich von Teak- und Brennholzforstungen mit Naturwaldstandorten im Lamawald (Süd Bénin) hinsichtlich ihres quantitativen Laubabbaus

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Die Streuauflage von abgestorbenem pflanzlichem Material ist eine wichtige Komponente von Waldökosystemen. Sie dient heterotrophen Organismen als Nährstoffquelle, als Nährstoffspeicher im Nährstoffkreislauf und reguliert die Hydrologie eines Standortes. Daraus resultieren Bodenfruchtbarkeit, durch Humusbildung und steigende Wasserspeicherkapazität, und Bodenstabilität. Der Abbau von organischem Material nimmt gerade in tropischen Ökosystemen eine wesentliche Rolle im Nährstoffkreislauf ein.

Die Abbaudynamik, die einerseits durch klimatische Gegebenheiten gesteuert und andererseits selbst auf Organismen und ihre abiotische Umgebung direkt einwirkt, variiert je nach Standort und Laubstreu. Unter dieser Hypothese steht das Freilandexperiment, das im Lamawald in Süd Bénin im Sommer 2002 durchgeführt wurde. Die Abbaurate von Blättern verschiedener Bäume und auf verschiedenen Waldstandorten wurde mit Hilfe der Litterbag Methode untersucht. Die Bäume umfassten zwei heimische Arten (*Afzelia africana, Ceiba pentandra*) und zwei exotische Arten (*Tectona grandis, Senna siamea)*. Die Standorte lagen in Teakaufforstungen, Feuerholzforstungen und natürlichem halbimmergrünem Wald.

Erste Analysen zeigen, dass die Abbauraten an natürlichen Waldstandorten höher sind als an Aufforstungen. Innerhalb der Laubarten baut *Afzelia a.*. am schnellsten, das *Tectona g.*. am langsamsten ab.

Der Einfluss von mikroklimatischen Faktoren auf die Abbaurate wird gegenwärtig noch untersucht.

Spacing patterns of the large pencil-tailed tree mouse, *Chiropodomys major*, in the canopy of a Bornean rainforest

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Spacing patterns and demography of the arboreal large pencil-tailed tree mouse, *Chiropodomys major*, was examined by live trapping in the subcanopy of a primary rainforest in Sabah, Malaysia over five months. Traps were placed on the ground and in the canopy at an averaged height of 13.5 m, where tree crowns are well interconnected. *C. major*, which was mainly active in the canopy, was by far the most frequently trapped species in this habitat layer. Home range areas were calculated as the 90 % core convex polygons for 18 individuals, for which sufficient recaptures (mean of 13) were obtained. Home range size varied between sexes, with males generally having larger home ranges (2971 ± 1104 m^2) than females (1580 ± 780 m^2). Home range areas of both sexes overlapped with those of consexuals and with individuals of the opposite sex, indicating that individuals do not maintain exclusive territories. Persistence rates were significantly biased by sex and age, as females persisted longer in the study area than males, and immatures expressed the lowest persistence rates thus showing little territorial behaviour. *C. major* used nearly the entire examined arboreal habitat space, but analysis of microhabitat preferences revealed that the activity of this arboreal rodent was significantly biased by the extend of tree connections and the presence of liana and gaps.

Salvia haenkei BENTH. and *S. orbignaei* BENTH. – two ornithophilous species from Bolivia and their hybrids

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Field investigations were carried out in Bolivia to study the pollination biology of ornithophilous *Salvia* species. Amongst the nine bird pollinated species observed, the shrubby species *S. haenkei* (Bolivia to Peru) and *S. orbignaei* (endemic to Bolivia) were studied in detail.
The following hummingbird visitors were observed: *Colibri coruscans, Sappho sparganura, Oreotrochilus adela*, and *Patagona gigas* in *S. haenkei*, *Chlorostilbon aureoventris in S. orbignaei.*
Both species agree in being pollinated by hummingbirds, but disagree in having a well working lever mechanism in *S. orbignaei* and a not working one in *S. haenkei.*
Further differences are the corolla colour and corolla form, form and position of upper and lower lip, position of anther presentation, morphology of nectar covers, style morphology and connective morphology.
Nevertheless, a hybrid swarm was found where both species occurred sympatrically (near Arani, Dept. Cochabamba). Here all above mentioned floral as well as certain vegetative characters showed a continuum between the parent species.
Although reproductive isolation between the parents obviously does not exist, the hybrids appear not to be competitive because seed set was very low and no larger population of any hybrid form was found.

The two examples of *S. orbignaei* and *S. haenkei* illustrate that the staminal lever mechanism may or may not function in ornithophilous species. Loss of function might be correlated with the tubular corolla form in S. haenkei. In any case the question arises about the evolutionary significance of the lever mechanism: if it ensures exact pollen placement, how do *S. haenkei*-like species compensate for its loss? And: does hybridisation increase with pollen mixture when at least one parent lacks the functional lever mechanism?

Räumliche Dynamik in der Krautschicht eines Forêt claire unter dem Einfluss ungeregelter Holznutzung in Benin, Westafrika

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Savannenformationen, die neben einer dichten Kraut- und Grasschicht eine Gehölzdeckung von mehr als 50% aufweisen, werden in Westafrika als Forêt claire bezeichnet (Yangambi-Konferenz 1956). Unter den Gehölzen finden sich vielfach Nutzholzarten, wie *Afzelia africana* oder *Isoberlinia doka* (Caesalpiniaceae). Neben anderen werden große Exemplare dieser Arten im Untersuchungsgebiet (Einzugsgebiet des Aguima, Dogue, Benin) ohne forstliche Aufsicht dem Bestand entnommen. In dieser Arbeit wurde der Einfluss der durch Baumfällung entstandenen „Lücken" auf die Vegetation der Krautschicht untersucht.
Ausgehend von einer Baumlücke wurden Transekte in den geschlossenen Bestand gelegt. Auf insgesamt vier Transekten, mit jeweils sechs aufeinanderfolgenden Untersuchungsflächen erfolgte die Aufzeichnung von Temperatur und Luftfeuchtigkeit über den gesamten Untersuchungszeitraum, der den Höhepunkt der Regenzeit sowie den Übergang zur Trockenzeit umfasste. Mit Hilfe von hemisphärischen Fotos wurden die Einstrahlungs- verhältnisse untersucht. Es wurden Bodenproben entnommen und periodisch die Bodenfeuchte gemessen. Auf allen Flächen wurden Vegetationsaufnahmen angefertigt und eine Biomassenprobe entnommen.
Insbesondere das Verhältnis von grasartigen zu krautigen Pflanzen veränderte sich in Bezug auf die Biomasseproduktion und Artmächtigkeit innerhalb der Transekte , was hinsichtlich der im Gebiet nicht zu vernachlässigenden Beweidung durch das Vieh der nomadischen Fulbe von gewisser Bedeutung scheint, da das Futterspektrum dieser Tiere hauptsächlich Poaceen umfasst.
In einem Monitoringversuch wurden auf den Transektflächen Exemplare der Poacaee *Andropogon tectorum* markiert und über einen Zeitraum von mehreren Wochen deren vegetative und reproduktive Aktivität erfasst. Hier zeigten sich die Auswirkungen der Beweidung recht deutlich, da es sich um eine bevorzugte Futterpflanze handelt.
Mit Hilfe der vorliegenden Daten ist es möglich, Aussagen über die Entwicklung der Kraut- und Grasschicht nach Holzentnahme und damit auch über die Verjüngung wichtiger Baumarten zu treffen.
Die Studie wurde im Rahmen des integrativen Managementprojektes für effizienten und tragfähigen Umgang mit Süßwasser in Westafrika (IMPETUS, gefördert vom BMBF) durchgeführt.

Veränderung der landwirtschaftlichen Nutzung im Alexander von Humboldt Nationalpark in Kuba seit der Gründung 1996 – eine qualitative Bewertung

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Im Alexander von Humboldt Nationalpark im Osten Kubas findet, wie in den meisten Nationalparks weltweit, traditionell landwirtschaftliche Nutzung (Ackerbau, Viehzucht) statt. Zur Bewertung der Veränderung der landwirtschaftlichen Nutzung seit der Gründung des Schutzgebiets im Jahr 1996 wurde der Nationalpark und die angrenzende Pufferzone im Jahr 2001 analysiert. Dies wurde im Bereich zweier Untersuchungsdörfer im Küstenbereich der Bahia de Taco durchgeführt. Gekennzeichnet ist dieses Gebiet durch ca. 2200 mm Niederschlag, da es im Osten eines Gebirgszuges und somit auf der Luvseite der vorherrschenden NO-Passatströmung liegt. Die Vegetation beinhaltet verschiedene Vegetationstypen, von Mangroven über halbimmergrünen Regenwald zu verschiedenen Ausbildungen von Trockenwäldern auf Serpentin.

Zunächst wurde eine Landnutzungskarte des Untersuchungsgebietes, unterteilt in sechs Klassen, erstellt: i) intensiv genutzte landwirtschaftliche Flächen, ii) extensiv bewirtschaftete landwirtschaftliche Flächen, iii) Flächen, die von Kokospalmen dominiert sind, iv) Flächen mit Sekundärvegetation, v) *Pinus*-Forste, und vi) Flächen mit natürlicher Vegetation (hauptsächlich Wälder und Mangroven). Daneben wurden auffällige Flächen im Untersuchungsgebiet in Bezug auf nachhaltige Landwirtschaft und Ressourcenschutz analysiert und bewertet. Zusätzlich flossen Informationen durch die Befragung von Parkwächtern und der Parkverwaltung in die Untersuchung mit ein.

Im Allgemeinen wirken sich die gegenwärtigen landwirtschaftlichen Nutzungsformen innerhalb des Nationalparks nicht unmittelbar in einer grundlegenden Degradation des Gebietes aus. Innerhalb des Parks wurden einige gefährdete Bereiche wie steile Hänge in den letzten Jahren aus der Nutzung herausgenommen oder extensiviert, während dies für die Pufferzone jedoch nur in geringem Maße festzustellen war. So stellt z.B. die Beweidung und der Anbau auf steilen Hängen und Bergrücken und die damit verbundenen Erosionserscheinungen eines der wichtiges Problemfelder dar. Hier wäre eine Nutzungsaufgabe empfehlenswert, damit durch eine Entwicklung hin zur natürlichen Vegetation des Gebietes auch dem Schutz der vielfältig vorkommenden Endemiten und der hohen Diversität von Flora und Fauna Rechung getragen werden könnte. Zwingend notwendig auf diesen Flächen wäre zumindest ein Extensivierung. Einen aus Nationalparksicht weiteren Problembereich stellen die im Untersuchungsgebiet nur kleinräumig vorhanden natürliche Waldbestände dar, da gegenwärtig große Flächen als Kiefernforste genutzt werden. In der Pufferzone zeigt sich die Problematik intensiver Beweidung und Anbaus deutlicher als im Nationalpark. Auf größeren Flächen müsste eine deutliche Extensivierung der Nutzung erfolgen, um einer Degradation entgegen zu wirken.

Als ein Grund für die relativ positiven Entwicklungen im untersuchten Nationalparkgebiet seit der Gründung des Schutzgebietes 1996 ist die verstärkte Zusammenarbeit der Parkwächter und der Parkverwaltung mit der lokalen Bevölkerung zu sehen sowie deren grundsätzlich positive Haltung in Bezug auf den Nationalpark. In der Pufferzone ist dies so nicht zu erkennen, da dort die Parkverwaltung keine Maßnahmen vorsieht.

Are raptors affected by a changing vegetation structure in arid savanna?

Matthias Wichmann; W. Richard J. Dean; Sue J. Milton, Florian Jeltsch

Biodiversity encompasses not only species diversity but also diversity in spatial and functional structures. In the Kalahari arid savanna large, solitary standing trees are essential to structural diversity playing a keystone role in maintaining the characteristic processes and supporting species performance. Giving an example, the tawny eagle (*Aquila rapax* Temminck) prefers tall, solitary standing trees for nesting but at the same time it needs open space for hunting interspersed with only few trees for perching. We use a spatial explicit version of an existing model of tawny eagle population dynamics (AQUIQUA) and found (1) the population persistence time to be limited by the availability of suitable nesting trees, and (2) that the availability of nesting trees is limited for both high and low tree densities. Various guises of human land use, such as cattle farming and wood cutting, modify tree densities in the Kalahari. We discuss possible impact on the persistence of the tawny eagle population.

Flexibility in echolocation: How does habitat structure influence sonar signal design of the neotropical bat Saccopteryx bilineata (Emballonuridae)?

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Flight and echolocation are key characters distinguishing most bats from other mammals. The echolocation sounds microchiropteran bats use in order to orientate and hunt in complete darkness are, in many cases, species-specific. Foraging habitat, foraging mode and diet are major factors that influence the structure of the signals across species.
However, also within each species the structure of echolocation signals strongly depends on the perceptional tasks that have to be performed by the bats. These tasks change for example completely when a bat moves from open space into more cluttered areas where it has to avoid obstacles and distinguish insect echos from echo cluttering background. Studies have shown that bats use long narrow-band echolocation signals for long-range echolocation. When hunting in more cluttered habtitats most bats change to brief, broadband signals or signal components, suited for texture discrimination and ranging by measuring echo travel times. The three major families of aerial insectivorous bats that occur in both Old and New World tropics (Emballonuridae, Molossidae, Vespertillionidae) show great variety in echolocation signal design. These bats almost entirely depend on echolocation for foraging – in contrast to the endemic neotropical family of phyllostomids, that combines the use of sonar with other sensory cues to find food. As they forage in similar habitats, phyllostomids show rather uniform signals.
In order to advance further in our understanding about factors influencing call design in bats and how call structure varies in relation to habitat structure, we studied the echolocation and hunting behaviour of *Saccopteryx bilineata* (Emballonuridae) in the field under natural conditions. The social behaviour of this species and the complex audible vocalizations that they produce mainly during the day are rather well studied. But only few studies have focused so far on its echolocation behaviour and its variability, in spite of the interesting structure of the signals: search and approach phase calls begin with a rise in frequency followed by a shallow-modulated middle part and a terminal drop in frequency. The calls are produced in pairs, the first 2-3 kHz lower than the second. The function of this frequency shift has not yet been revealed entirely. Associations with doppler shift compensation, increase in bandwidth, expansion of detection range or social communication have been suggested.
To study echolocation behaviour of these bats we documented free flying, naturally foraging *Saccopteryx* in various habitats and situations on Barro Colorado Island (Panama), using 3D-multiflash photography combined with simultaneous sound recordings. With a special computer programm we reconstructed the bats' flight positions in three dimensional space and correlated it with the corresponding echolocation sequence. With this method we could not only associate signal types with habitat types and document changes in bandwidth, sound duration and pulse interval but also measure exact flight speed and reaction distance to insect prey or obstacles. We further linked sound emission to wingbeat. Additional recordings in a flight cage supported our hypothesis of great complexity and variability in the echolocation behaviour of *Saccopteryx bilineata*. For the first time we documented the use of ultrasound clicks besides echolocation signals in a microchiropteran bat. Presumably, these clicks are also used for orientation in space. So far such clicks are only known from the flying fox genus *Rousettus* (Megachiroptera).

Forest fragmentation process increases density of leaf-cutting ants in the Brazilian Atlantic rain forest

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Because of their multifarious effects on the vegetation, leaf-cutting ants (LCA, e.g. *Atta* spp.) have been denoted as key species of American rainforest ecosystems. Being dominant herbivores, they significantly and directly affect individual plants and plant communities through the removal of foliage. On the other hand, their effects on the ecosystem include modification of the nutrient cycling, creation of vegetation gaps at the nest site, and seed dispersal of forest plants. Therefore, the density, distribution, and size of LCA colonies in a particular area are of considerable ecological importance. During the last decades the abundance of LCAs has been realized to dramatically increase with disturbance of tropical forests. The ecological processes leading to this increase are subject of a research project on the effects of fragmentation on the trophic cascade "plant - leaf-cutting ant/fungus - predator/parasite" (see other contributions to this meeting). Here, we investigated whether fragmentation of the Brazilian Atlantic rainforest affected the population density of LCAs. Using a transect method, we surveyed *Atta* spp. colonies at the Usina Serra Grande field site, the largest Atlantic rainforest remainder in NE-Brazil. We sampled 29.6 ha in continuous forest and 4.7 ha in forest fragments along transects with fixed belt width of 10 m. A total of 53 *Atta* colonies were recorded, with 29 in continuous and 24 in fragmented forest. This corresponded to a significant difference in colony density ranging from 1.1 colonies ha^{-1} in continuous forest up to 5.9 colonies ha^{-1} in fragmented forest. The results are in line with earlier observations indicating that deforestation and habitat fragmentation leads to a considerable increase of colony densities of LCAs.

Growth modelling of timber species in Amazonian floodplain forests

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The nutrient rich floodplain forests along the Amazon River and its major tributaries (*várzea*) are endangered due to conversion into areas for agriculture and an expanding timber industry. To resolve the conflicts between the protection of the multiple functions of the floodplain forests and the use of its natural resources the development of sustainable forest managements is a promising way. In the Mamirauá Sustainable Development Reserve (Central Amazonia) a forest management has been established in co-operation with the local residents restricted to harvest 5 trees ha^{-1} with a minimum logging diameter (MLD) of 45 cm and a cutting cycle of 25 yrs. However, the sustainability of this management concept has to be questioned because there are no sufficient information about growth rates of these timber species. The objective of this study is to construct growth models for different timber species (hardwood and softwood) analysing time-series of tree rings, which are formed annually in response to the long-term flooding. The models allows to estimate specific cutting cycles and the favourite diameter for logging to guarantee a sustainable and efficient use of the natural timber resources.

From 11 timber species cross sections and cores were sampled and analysed using dendrochronological methods to construct cumulative diameter curves. Height growth was directly modelled by stem analysis or indirectly combining cumulative diameter growth curves and non-linear regression models of diameter-height relations. Volume growth was estimated by basal area multiplied with the tree height and a form factor of 0.5. The wood density was determined using cores.

Softwood species (wood density <0.60 g cm^{-3}) needs 30-60 yrs to reach the current MLD, while the hardwood species (wood density >0.60 g cm^{-3}) pass over this limit in periods between 100 and 140 yrs. With increasing wood density the volume increment culminates much later. The MLD is derived from the maximum current volume increment, which lies for all timber species above the actual limit of 45 cm. The mean passage time through 10 cm diameter-classes until the tree reaches the MLD is defined as cutting cycle, which correlates significantly with the wood density ($r = 0.95$, $p < 0.01$). For the softwoods the cutting cycle is between 6 and 13 yrs, for the hardwoods the models predict cutting cycles of 22-31 yrs.

Management options with a fixed cutting cycle and minimum logging diameter do not consider the different growth behaviour of tree species leading to an overexploitation of hardwood timber species and an inefficient use of the growth potential of softwood species mainly used by the growing sector of plywood industries in the Amazon basin. Thus specific cutting cycles and minimum logging diameters has to be applied in the current forest management to reach a higher degree of sustainability and economic efficiency.

Heterogeneities of soil physics parameters on plot scale and their impact on water fluxes in tropical mountain forests in the South Ecuadorian Andes

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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 and gas transport are determined as a prerequisite for the quantification of water and matter fluxes in soils. Matter fluxes are regarded as sensitive indicators for land use changes and are of fundamental importance for the evaluation of ecosystems with anthropogenic impacts with regard to sustainability and environmental acceptability. An important property of the soil is spatial variability of soil hydrological characteristics and soil physical parameters.

The study area belongs to the Estación Científica San Francisco and is located in the Andes in Southern Ecuador between the cities of Loja and Zamora on the northern border of the Podocarpus National Park. Spatial variability was investigated on two different scales: the catchment scale and the plot scale. Here first results of the plot scale are presented. Data was obtained on a 1.5 m x 4 m soil profile face at 1900 m above sea level in the lower part of the likewise investigated micro-catchment covered mainly with tropical lower montane forest.

The 1.5 m x 4.0 m soil profile face was prepared and described. Disturbed and undisturbed soil samples were collected. Based on a 10 cm grid the soil texture was estimated. Furthermore the position, size, orientation and shape of over 100 stones were measured. An Artificial Neuronal Network was used as pedotransfer function to estimate the matric potential-water content and the conductivity function.

Two-dimensional simulations of water transport were carried out to investigate the impact of the spatial variability of soil hydrological characteristics, soil physical parameters and stones. Patterns with different water-flow velocities are developed with areas with preferential flow on the one hand and areas of stagnation on the other hand.

Photosynthetic Responses of Plants to Elevated CO2 and Possible Effects on Community Composition and Succession in Different Lower Subtropical Forests in South China under Global Change

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In lower subtropical area large amount of plant species are found in common with those in the close tropical regions in South China. Of them, *Rhodomyrtus tomentose*, *Schima superba* and *Psychotria rubra*, and *Ardisia quinquegone* are representative plants growing in an open, a medium dense and a highly dense forest respectively in this lower subtropical region. They are namely sunny, mesophytic and shady species. Photosynthetic rate in leaf of *R. tomentose* increased with an enhancement of irradiation under higher CO_2 concentration. The initial slope of the relationship between photosynthetic rate and irradiation density was 0.051 for *R. tomentose*, while it was 0.039 for *S.superba* and 0.034 for *P. rubra*. Much lower value of 0.022 was found in *A. quinquegone*. The CO_2 compensation point in absence of respiration in light, *G* *, was 38.1μl L^{-1} for *R. tomentose*. It was higher than those of *S. superba* and *P. rubra* by 8.8% and 10.7%, and even higher than that of *A. quinquesgone* by 14.7% respectively. (*Rd*), Similar *Rd* values were measured in the other 3 species except for *A. quinquegone* that had lower light respiration rate. The Rup2-saturated CO_2 assimilation rate (*Vc*max) of *R. tomentose* was 80.2μmol m^2 s^{-1}, higher than those for *S.superba* and *P. rubra* by 24.4% and 22.9% respectively, suggesting that *R. tomentose* may have higher potential carboxylation. The actual electron transport rate (*Ja*) is related to Rup2-regenerating rate. *Ja* was 102.7μmol m^{-2} s^{-1} in *R. tomentose*, significantly higher than those of the other species growing in medium and highly dense forest sites. The light energy conversion efficiency (*d*) was 0.47 electrons per quantum in *R. tomentose* and 0.23 and 0.26 electrons per quantum in *S. superba* and *P. rubra*. The results show that photosynthetic rate could be increased as air CO_2 concentration was increased in plants grown on the open sites where photosynthetic sink is not limited. The enhancing CO_2 may facilitate the development of species in the open sites of lower subtropical forests.

Research results indicated that sunny species under elevated atmospheric CO_2 had relatively higher maximun RuBP-saturated carboxylation rate and electron transfer rate. Long-term elevated CO_2 would favor the growth of sunny tree species that could occupy the community for even longer time if the habitat disturbance due to global change will occur continuously. It would be unfavorable for the invasion and growth of mesophytic and shade-tolerant species. The vegetation community would therefore have to take much longer time to success to climax period.

Key words: Lower subtropical forest, Photosynthetic response, Global change, Elevated CO_2 Community composition

Enset (*Ensete ventricosum*) landraces in different geographical and altitudinal regions of Ethiopia and changes in their regional distribution

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Enset (*Ensete ventricosum*, family. Musaceae) is widely distributed in eastern and southern Africa but cultivated only in southern and southwestern Ethiopia as staple food for about 15 million people in mixed subsistence farming systems. The main product is starch extracted from the underneath corm and the leaf sheaths. Moreover, all parts of the plant are used in household, agriculture and for traditional medicinal treatments. Cultivation areas extend from 1700 to 3300 meters altitude with annual average temperatures between 8°C and 22°C and annual precipitation between 900 and 1500 mm. Dry periods lasts from 3 to 8 months. A large number of landraces is described by the farmer, who distinguish them by their morphology and potential use. Culltivation is done vegetatively by sprouts and rarely by seeds.

Farmer in ten enset cultivation regions were visited in 1994 and 1998-1999. They were interviewed about the landraces they grow and the plants' uses. Their plantations were visited and location, altitude and soil quality of each farm were recorded.

Morphological criteria to distinguish landraces are colour of leaf sheaths, midrib and lamina, girth and shape of pseudostem, width of lamina, total height of plant at flowering stage and fibre content and strength of leaf sheathes and corm. There are differences in yield and processing properties due to starch and fibre content. Secondary plant ingredients influence taste and are of importance in traditional medicinal treatments for humans and animals, e.g. curing broken bones, diarrhoea and contraception. Landraces with high phenol content seem to be less susceptible to drought, frost and pathogens, but less suitable for fermentation, and are less preferred for human consumption due to their bitterness.
30 to 60 landraces were recorded, but many local synonyms are used. New races are selected from seedlings, spontaneous mutation or are exchanged from neighbouring regions. Most landraces were recorded in regions where enset is of high importance for the local ethnics. With increasing altitude the number of cultivated landraces diminishes.
Distribution of landraces from their original growing areas to other regions became important after the drought in 1984/85 when plantations were almost exhausted and farmer had to buy plants from distant regions. Based on positive experiences farmer recently show more interest to grow new landraces to improve the potential of their plantation. Imported landraces are often named according to their native region but not with its original name, therefore identification is difficult.
Comparing the results with older literature it is evident that some names of landraces disappeared but new ones appeared. Investigations in 1994 and 1998-1999 showed different frequencies of certain landraces. The successful introduction of one extremely frost susceptible but highly favoured landrace to high altitudes was noticed in 1998. These changes are due to preferences of the farmer and improved infrastructure but possibly also due to climatic changes. Approximately 20 to 30 genetically different landraces might exist. Clasisfication of genotypes might be helpful to identify landraces, their migration and genetically determeined site requierments.

BIOTA West

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The interdisciplinary research project BIOTA West (Biodiversity Monitoring Transect Analysis in Africa, Subdivision West Africa), funded by the BMBF, started at 01.01.2001. The field studies are executed in Benin, Burkina Faso and Côte d'Ivoire.

The participating institutes with their projects and the responsible project leaders within BIOTA West in Germany are:

W01: Remote sensing and GIS based survey of spatial and temporal biodiversity dynamics and analysis of biodiversity and ecodiversity interrelationships

Dr. Bianca Hörsch, DLR, German Remote Sensing Data Center, Linder Hoehe, D-51147 Köln

W02: Biophysical and hydrometeorological parameters within the framework of terrestrial biodiversity research

Dr. Jörg Szarzynski, Center for Development Research, Walter-Flex-Str.3, D-53113 Bonn

W03: Biodiversity of Africa in the global context: spatial patterns of vascular plant diversity in a changing environment (BIOMAPS project)

Prof. Dr. Wilhelm Barthlott, Dr. Jens Mutke, Botanical Institute, Meckenheimer Allee 170, D-53115 Bonn

W04: Phytodiversity and dynamics of habitat fragments in Côte d'Ivoire: spatial and temporal patterns of biodiversity changes, edge effects, and their functional consequences in natural and disturbed ecosystem mosaics

Prof. Dr. Stefan Porembski, Institute of Biodiversity Research, Wismarsche Strasse 8, D-18051 Rostock

W06: Determinants of small-scale mosaics of arthropod communities in natural and anthropogenicly disturbed habitats

Prof. Dr. K. Eduard Linsenmair, Animal Ecology and Tropical Biology, Am Hubland, D-97074 Würzburg

W07: Fish communities in the ephemeral savanna waters of the Comoé Nationalpark, Côte d'Ivoire, West Africa

Prof. Dr. K. Eduard Linsenmair, Animal Ecology and Tropical Biology, Am Hubland, D-97074 Würzburg

W08: Measuring and monitoring Amphibian diversity in West Africa: separating global from regional and local causes

PD Dr. Michael Veith, Institute for Zoology, Saarstrasse 21, D-55099 Mainz

Dr. Mark Oliver Rödel, Animal Ecology and Tropical Biology, Am Hubland, D-97074 Würzburg

W09: The influence of local and regional factors on the diversity, structure, and function of West African bat communities (Chiroptera)

Prof. Dr. Elisabeth Kalko, Experimental Ecology (Bio III), Albert-Einstein Allee 11, D- 89069 Ulm

W11: Phytodiversity in the West African Sahel and Sudan Zone - Development and Evaluation

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Unterschiede in Nährstoffaustattung und Struktur zwischen Blättern von Kletterpflanzen und ihren Trägern in einem ecuadorianischen Bergregenwald

Jörg Salzer

Anhand von Blattproben aus einem Bergregenwald im südlichen Ecuador wurden die Unterschiede von Kletterpflanzen und selbsttragender Vegetation paarweise untersucht: Hierzu wurden Zweige aus demselben Bereich innerhalb der Pflanzenpaare entnommen. Die Arbeiten wurden entlang eines Bergrückens zwischen 1900 und 2700 m ü. NN auf unterschiedlich stark strahlungsexponierten Flächen durchgeführt. Das relative Lichtangebot und der LAI wurden über jeder Entnahmestelle bestimmt. Die Blätter wurden frisch gescannt, anschließend getrocknet, gewogen und auf ihre Mineralstoffgehalte analysiert.

Die insgesamt 83 gesammelten Pflanzenpaare setzen sich aus 21 verschiedenen Kletterpflanzenspezies (13 Familien) und 32 Trägerpflanzenspezies (15 Familien) zusammen. Ein Chi²-Test ergab keine signifikanten Zusammenhänge zwischen den drei häufigsten Kletterpflanzengenera und bestimmten Trägern, obwohl beide Wuchsformen teilweise nur auf bestimmten Untersuchungsflächen gesammelt wurden. Unabhängig von der systematischen Zuordnung wiesen die Kletterpflanzen auf allen Standorten eine geringere spezifische Blattmasse (LMA Kletterpflanze: $93,5 \pm 40,2$ g m^{-2}; Träger: $163,4 \pm 76,9$ g m^{-2}; $p < 0,001$) auf. Die LMA-Werte nahmen bei den Trägerpflanzen mit zunehmender Strahlungsintensität stärker zu. Auch bei Betrachtung des flächenbezogenen Stickstoffgehaltes N_{area}, welcher bei den Trägern höher lag (Kletterpflanze: 1376 ± 514mg m^{-2}; Träger: 1843 ± 606mg m^{-2}; $p < 0,001$), ergab sich eine Abhängigkeit vom Strahlungsangebot. N_{area} korrelierte bei den Kletterpflanzen stärker mit der relativen Strahlung (Kletterpflanze: $r^2 = 0,53$; Träger: $r^2 = 0,25$) und streute bei vergleichbaren Lichtbedingungen geringer als die der Träger, was auf die bessere Anpassungsfähigkeit dieser Wuchsform hinweist. Auch bei der Ausstattung mit anderen Mineralstoffen ergaben sich meist signifikante Unterschiede. Eine weitere Abstraktion und Gruppierung der erfaßten Parameter mit Hilfe einer Principal Components Analysis ergab für beide Wuchsformen vier nahezu identische Faktoren. Faktor 1 wurde in beiden Fällen durch die Parameter Meereshöhe, relative Strahlung, LMA, N_{area} und C_{area} (Flächenbezogener Kohlenstoffgehalt) bestimmt.

Die Reduktion der Biomasseinvestition von Kletterpflanzen in Stützgewebe, wie von Stämmen und Zweigen bekannt, setzt sich also auch auf der Blattebene fort. In Kombination mit einer optimierten Mineralstoffaustattung bedingt dies die hohe Konkurrenzkraft dieser Lebensform, besonders an Stellen mit hinreichender Stickstoffversorgung. Die punktuell hohe Abundanz von Kletterpflanzen wird somit durch obige Untersuchung besser verständlich.