Newsletter

DFG Research Unit 816:
Biodiversity and Sustainable Management of a Megadiverse Mountain Ecosystem in Southern Ecuador

Issue 17
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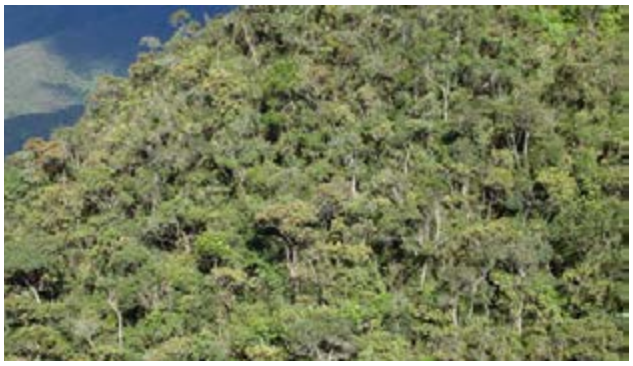

The vast biodiversity of the tropical mountain forests attracted German scientists to start interdisciplinary biodiversity research in the remote area of the Ecuadorian Rio San Francisco Valley (left). Now, after 15 years of German-Ecuadorian research, they have unveiled features hitherto unknown regarding ecosystem constitution, functioning, and services. As they observed this unique ecosystem is locally threatened by non-sustainable land uses like pasture farming (right). Therefore they developed a science-directed sustainable land use portfolio based on their results and the resilience of the ecosystem against environmental changes. In this issue the Research Unit 816 (RU) briefly presents its latest findings (Science News) and a summary of the last five years of research. Their recommendations include intensification, diversification, restoration and conservation (Speakers' Corner), and to monitor the impacts of ongoing environmental change. Photos: RU.

Speakers' Corner

Past Activities

In April 2012, our Research Unit 816 (RU) has contributed with information material and the science TV movies from the German Research Foundation (DFG) to an exhibition of German coordinated global change research programs. The exhibition was managed by the German National Committee on Global Change Research at the conference "Planet under Pressure" in London which was organized by the global change research programs of the International Council for Science (ICSU). For more information, please refer to reference [1].

Over the last months the speakers were exceedingly busy with the preparation of the proposal for the three bundle projects of the new program "Platform for Biodiversity and Ecosystem Monitoring and Research in South Ecuador" (TMF-Newsletter no 15, doi: 10.5678/lcrs/for816.cit.1049). In the preparation phase, several meetings were conducted with Ecuadorian non-university and university cooperation partners, with relevant Ecuadorian administrative bodies, and with funding agencies. In May, the speaker Professor Dr Jörg Bendix undertook a journey to Ecuador for the final coordination of the new program.

Negotiations for Joint German-Ecuadorian Funding

A first meeting took place on 9th May 2012 at the head office of the Ecuadorian funding agency SENESCYT (Secretaría Nacional de Educación Superior, Ciencia, Tecnología e Innovación) in Quito between representatives of the RU (on behalf of the German consortium), the planned SENESCYT bundle program represented by the designated deputy speaker of the Ecuadorian consortium, Dr Alfredo Martinez, and SENESCYT staff headed by Subsec-

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retario Hector Rodriguez. The speaker introduced the proposed German-Ecuadorian program which was acknowledged by Subsecretario Rodriguez as of major importance for the country. He particularly emphasized that the planned scientific network of Ecuadorian Universities is in absolute compliance with the brand new national strategy towards a funding priority of coordinated research programs. Also, the state of the framework agreement on a research cooperation between DFG and SENESCYT was discussed.

Explore Options for Synergies with the Ecuadorian GIZ Program

A subsequent meeting at the Ecuadorian office of GIZ (Deutsche Gesellschaft für Internationale Zusammenarbeit) in Quito with the head officer Barbara Hess and the local expert for sustainable land use and conservation Christian Fedlmeier had the aim to discuss potential synergies of the planned German-Ecuadorian and running GIZ projects. It turned out that GIZ has to wait for the official governmental negotiations between Germany and Ecuador (scheduled for October 2012) that will result in a new GIZ program agenda which might be coordinated at a later stage with our activities. A mutual exchange of project information was agreed.

Planning the Joint Development of the Prototypes with the Ecuadorian non-University Cooperation Partners

On 10th May 2012, a meeting with the non-university cooperation partners NCI (Foundation Nature and Culture International), represented by Director Renzo Paladines, and ETAPA, represented by Dr Alfredo Martinez, was used to detail the joint development of the planned prototypes of global change indicators in the scope of the new program. Later, a meeting with the director of ETAPA, Economist Oswaldo Larriva, was arranged to agree on contributions of ETAPA to the research infrastructure of the platform. On 12 May a planning meeting with the director Ing. Diego Ramón of the regional water fund of southern Ecuador FORAGUA (Fondo Regional del Agua) was organised at NCI's office in Loja where the layout of the joint prototype development was refined. On 15th May a technical meeting with the prefect of the province of Loja, Ing. Rubén Bustamante, and the planning department (**Figure 1**) had the aim to proceed with the implementation of the rain radar knowledge transfer project (see article "second transfer project" in the issue) which will

Figure 1: Prefect Rubén Bustamante (left) in conversation with the RU speaker, Professor Jörg Bendix (right), staff members of the planning department of the Provincial Government of the province of Loja (GPL) and non-university and university partners (the foundation Nature and Culture International, the Technical University of Loja, University of Cuenca) at GPL's head office in Loja. The discussion concerned the implementation of the radar network south Ecuador and the aims of the new Ecuadorian-German platform initiative. Photo: GPL

also contribute valuable monitoring data to the platform. On this meeting, the speaker also presented the planned platform program and its importance for the improvement of the radar network. The platform coordination activities ended with a meeting at the fourth non-university partner at Zamora. The prefect Dr Salvador Quishpe of the province Zamora-Chinchipe (**Figure 2**) and representatives of the municipality of Zamora mutually agreed on the contribution of the Gestion Zamora to the joint development of the prototypes of knowledge transfer.

Arrangements with the Ecuadorian Ministry of the Environment

On 11th May, a meeting at the Ecuadorian Ministry of Environment (MAE) in Quito with representatives of MAE, headed by Subsecretaria Tania Villegas, and the German-Ecuadorian consortium was held to discuss information exchange and research permissions issues for the platform program. After an introduction of the new program by the speaker, MAE showed particular interest in accession to the monitoring data collected by the platform, as part of a national monitoring system which has to be established in the country. Regarding data base issues, a follow-up meeting was agreed to discuss the details of a data exchange strategy on the technical level. The second point related to the application for a research permission for the platform was the question of developing a *contrato marco* (framework contract) which is on the mid term required to implement Convention on Biological Diversity (CBD) regulations in the country. Because the National Focal Point, Dr Wilson Rojas, could not attend the meeting, further discussions were postponed to a later meeting.

Towards Data Exchange with MAE

The technical meeting on database issues appointed in May by the speaker and MAE took place on 14th June at the headquarters of MAE in Quito between representatives from MAE (Lorena Falconi - Undersecretary for Climate Change, Isabel Endera - National Director for Biodiversity, and the MAE database team), from the Technical University of Loja UTPL (Nelson Piedra - Director of Knowledge Transfer, Augusta Cueva - Director of Natural Sciences Department), and from the RU (Thomas Lotz - data manager, Felix Matt and Jörg Zeilinger - station managers). MAE announced great interest in a trilateral cooperation between MAE - UTPL - and the proposed German platform data base project to make the data of the “Platform South Ecuador” available for the MAE ecologists, planners and deciders. The technical realization of an adequate interface shall be supported particularly by the Computer Science Group of the UTPL.

Figure 2: Prefect Dr Salvador Quishpe (left) talks with RU Speaker Professor Jörg Bendix about joint prototype development at the Provincial Government’s head office in Zamora. Photo: Felix Matt

Future Arrangements on Research Permissions

The second meeting appointed in May 2012 on the *contrato marco* was realized at MAE head office in Quito in the Department Dirección Nacional de Biodiversidad on 14th June 2012. Participants were the National Focal Point Dr Wilson Rojas, Cristina Quiroga from the Dirección Nacional de Biodiversidad, and Martínez for ETAPA. The RU was represented by the local managers Jörg Zeilinger and Felix Matt. For now the result was, not to apply for a *contrato marco*. The platform program shall still be operated on the basis of a regular research permission where a *contrato marco* shall be jointly developed at a later stage of the program.

Research Cooperation between German and Ecuadorian Science Foundations

On 23rd May 2012 the deputy speaker Professor Dr Dr h.c. Erwin Beck met an Ecuadorian delegation and DFG representatives at the DFG office in Berlin to attend the signing ceremony of a research cooperation between the Ecuadorian and the German science foundations. In an opening address, he emphasized the excellent research relation between both countries using the example of the joint research activities of the RU816 and the foregoing projects in southern Ecuador. The framework agreement for scientific cooperation was signed by the president of the DFG, Professor Dr-Ing Matthias Kleiner, and the Ecuadorian ambassador S.E. Jorge Jurado on behalf of René Ramírez Gallegos, the National Secretary of SENESCYT. The

agreement is generally open to all disciplines but the planned platform project is intended as a pilot project for joint funding of integrative biodiversity research. For more information on the agreement, the reader may refer to [2].

Proposal Submission Status

Eventually, after several months of careful preparations, all German proposals could be successfully uploaded via the new DFG eLan system mid of July as a first test case for such types of projects. The Ecuadorian consortium was asked to submit their proposal to SENESCYT by the end of September 2012.

15 Years of German-Ecuadorian Research

The proposed platform endeavor consists of three different bundle projects where two bundles are applying for funds in the scope of the DFG knowledge transfer funding line. This means that the intended research and the development of prototypes are heavily based on already gained data and knowledge of previous basic research activities in the platform area of southern Ecuador. Therefore, a brief historical sketch is given.

The DFG-funded core research in southern Ecuador started with six projects in 1997 which were mainly working on biotic and abiotic inventories of this highly unknown ecosystem (**Figure 3**).

A first collaborative research unit (RU402 "Functionality in a Tropical Mountain Rainforest: Diversity, Dynamic Processes and Utilization Potentials under Ecosystem Perspectives") started in 2001 with ten projects, steadily increasing in size to 25 projects to-

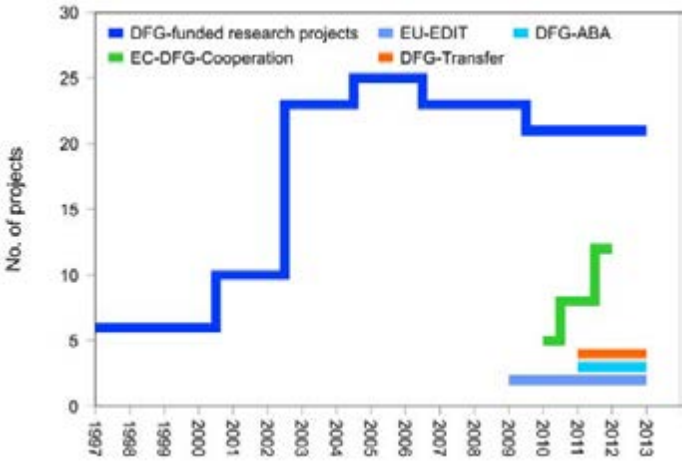

Figure 3: Funded projects working in southern Ecuador; bluish colors indicate research projects, green colors indicate capacity building and red colors the transfer of basic knowledge to application. Further explanations are provided in the text.

Table 1: Allocated funds for the promotion of women

RU Project Number	Applicant (year of application)	Funding for
B1	Dr Kristin Roos (2011)	Project on genetics of spatial bracken fern distribution in the Rio San Francisco valley
A2	Tessa Camezind (2011)	Relief personnel for parental leave
A3	Valentyna Krashevska (2011)	Relief personnel for child care
B1	Dr Kristin Roos (2012)	Project on genetics of spatial bracken fern distribution in the Rio San Francisco valley
D2	Franziska Volland (2012)	Relief personnel for child care

wards the third phase 2005-2007. The main focus of the research program was to investigate ecosystem functioning along environmental gradients. The still running research unit RU 816 "Biodiversity and Sustainable Management of a Megadiverse Mountain Ecosystem in South Ecuador" which will close in 2013 works since 2007 with nearly the same number of projects, but was and is focused on analyzing ecosystem functioning and services in both manifestations of the ecosystem, the natural forest and the pastures and abandoned areas.

In the second phase of our current RU (RU816), special funds were allocated by DFG for the promotion of women (**Table 1**). The funds are invested to prevent from interruptions in PhD-careers of femal PhD candidates due to the impossibility of conducting field work resulting from the necessity of child care activities in Germany. A second funding line is targeted to young female PostDoc researchers which should be enabled to develop their project planning, administration and implementation capabilities. With this instrument, small projects could be acquired which should be conducted together with a female Ecuadorian PhD candidate. To date, one of such projects is successfully run by Kristin Roos (refer to findings "Gender equality measure", p. 28, this issue).

The latest DFG-funded program of basic research starting work in the San Francisco Valley was the ABA-Ecuador bundle ("Accelerated Biodiversity Assessment") in 2011 with three projects aiming at new and effective screening methods to rapidly assess biodiversity in the study area (see TMF Newsletters no 9, doi: 10.5678/lcrs/for816.cit.1002 and 10, doi: 10.5678/lcrs/for816.cit.1001).

Besides DFG funded projects, also two (out of 27) EU WP7-funded basic research projects of the EDIT-

ATBI+M (European Distributed Institute for Taxonomy-All Taxa Biodiversity Inventories and Monitoring) program joined the German research activities at Reserva Biologica San Francisco (RBSF) in late 2008, mainly devoted to species inventories. Because of the excellent research conditions regarding infrastructure and ancillary data in the RBSF, they could recently finish their research with great success (see also p. 29, this Newsletter, substantially increasing the international visibility of the RU.

With regard to capacity building, a program for autonomous scientific staff development, the so-called collaboration program, was launched in late 2009 with five projects designed and mainly funded by the Ecuadorian partner. The third phase of the collaboration program - consisting of 12 projects – now also includes two universities from Cuenca (**Table 2**).

After 15 years of research, first projects devoted to basic research gained relevant knowledge and developed techniques which are prone to get transferred to application. The first example is the DFG-funded knowledge transfer program “Nuevos Bosques para Ecuador” (see this issue p. 10 and TMF Newsletters no 14, doi: 10.5678/lcrs/for816.cit.1031) consisting of four projects to conduct afforestation with native trees. The second recently approved knowledge transfer project (“Rain Radar Network South Ecuador”, see this Newsletter, p. 11) will implement a radar network in southern Ecuador for the whole platform which provides spatial explicit rainfall and severe weather monitoring.

Data and Research Infrastructure

Over the years, a wealth of baseline data and information were and still are collected in the natural forest and the replacement system “pastures” of the Rio San Francisco Valley, but also from the dry forest in Laipuna. A detailed compilation is given in the first chapter of the Extra-Newsletter no 15 (2011) of the RU (doi: 10.5678/lcrs/for816.cit.1049).

The biotic data gathered range from comprehensive inventories of flora and fauna (above- and below ground) to information regarding ecosystem functioning (e.g. litter decomposition, tree phenology etc.) and services (as e.g. on the biotic-ecological basis of regulating and provisioning services related to carbon sequestration, afforestation with native trees or sustainable pasture management). Abiotic data from the atmo-, hydro- and pedospheres are gained, also with special reference to ecosystem functioning and services (as e.g. climate and water regulation).

Part of the collected time series (e.g. climate data from meteorological field stations) date back to the beginning of the research in 1997. Other data are derived from spatially explicit data sources e.g from Remote Sensing. Inventories of socio-economic factors in the Estación Científica San Francisco (ECSF) area are hitherto related to land use systems of the population in and around the valley with particular reference to indigenous groups. Methods for data acquisition are ranging from single and/or recurring household and farm surveys up to remote sensing technology. All data are stored in the further developed RU data warehouse (RU816dw) using international data and metadata standards. To date the data stock of the RU816dw encompasses more than 29 Mio single data.

Table 2: Autonomous staff development in ecosystem research. Bilateral cooperations between German and South Ecuadorian universities: third phase (2011-2012)

Sub-project number	Cooperating partners (EC / G) **PhD candidate**	Cooperating University EC
1	Suárez / Bendix & Rollenbeck **V. González**	Universidad Técnica Particular de Loja (UTPL)
2	Célleri & Feyen / Breuer **Quichimbo**	University of Cuenca
3	Suárez / Frede **Iñiguez**	Universidad Técnica Particular de Loja (UTPL)
4	Aguirre / Günter & Knoke **Torres**	Universidad Nacional de Loja (UNL)
5	Suárez / Homeier Tapia	Universidad Técnica Particular de Loja (UTPL)
6	Suárez / Kottke & Piepenbring **Cruz**	Universidad Técnica Particular de Loja (UTPL)
7	Suárez / Makeschin **Izquierdo**	Universidad Técnica Particular de Loja (UTPL)
8	Valarezo / Wilcke **E. Gonzáles**	Universidad Nacional de Loja (UNL)
9	Zarate / Farwig **Astudillo**	Universidad de Azuay
10	Cazar / Richter **Minga**	Universidad de Azuay
11	Suárez / Wägele **Sotomayor**	Universidad Técnica Particular de Loja (UTPL)
12	Suárez / Wägele **Leiva**	Universidad Técnica Particular de Loja (UTPL)

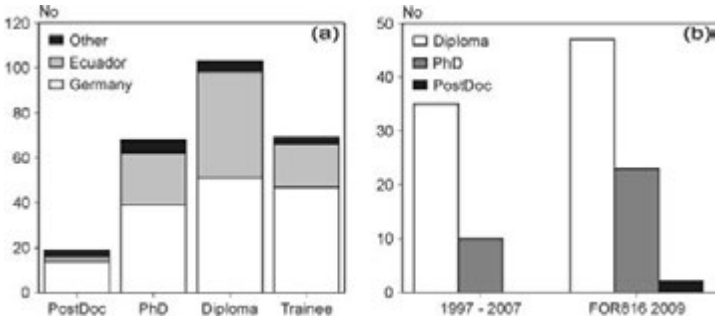

Figure 4: **(a)** Researchers at all academic levels working in the research unit **(b)** Number of Ecuadorian researchers since the beginning of the research activities in southern Ecuador (Source: datawarehouse RU816-DW, www.TropicalMountainForest.org).

Research in the Reserva Biologica San Francisco (RBSF) highly benefits from the well-developed infrastructure which primarily encompasses continuous logger-based measurements of abiotic (e.g. climate stations, river gauges, soil water etc.) and biotic (e.g. tree growth) parameters. Of particular importance and value are the well-equipped experimental sites for joint ecological experiments in the natural forest and the replacement system, as some of these sites date back to the beginning of the research in 1997. Good examples for such experiments aiming at ecosystem functioning are the two compatible nutrient manipulation experiments (NUMEX in the forest and FERPAST on the pastures). Last but not least, a wealth of field data allow adaptation and parameterization of several numerical models for the area, ranging from climate to socio-economic simulation approaches. These models can be used to play through land use scenarios or to provide future projections of global change impacts on the ecosystems. The research station ECSF itself with its facilities (herbarium, labs, IT etc.) is the focal infrastructure for all projects working in the valley.

Three Pillars of Capacity Building

In the sense of Access and Benefit Sharing (ABS) of the CBD, capacity building was one of the major inherent parts of the research program.

In the process of developing excellent collaboration between four top universities in southern Ecuador[1] and the research programs, joint research infrastructure has been successfully promoted and/or equipped, as among others, a laboratory for molecular biological and genetic studies at the UTPL, facilities for water isotope signature analysis at the University of Cuenca and a lab for dendroecology as well as a greenhouse for the tree nursery at the National University in Loja (UNL).

1 The Technical University of Loja (UTPL), the National University of Loja (UNL), the University of Cuenca and the University of Azuay in Cuenca.

A second pillar of capacity building was to educate and train Ecuadorian students, technicians and scientists at all academic levels in the research programs. This was realized by Ecuadorian students preparing their Bachelor, Maestria or PhD theses in the research programs. **Figure 4 (a)** clearly reveals the outstanding success of capacity building achieved in the course of the 15 years of collaborative research. A reasonable part of the researchers, particularly at the diploma/tesistas and PhD levels are meanwhile Ecuadorian collaborators. The increasing shares in the Ecuadorian researchers over 15 years of research (**Figure 4 b**) reveals that the absolute number but also the academic level of the contributing Ecuadorian scientists could be significantly increased.

The third pillar of our capacity building activities is the promotion of scientific staff for the local universities. With the new Ecuadorian laws on higher education, the local universities must strive for an upgrade of their scientific staff in the way that every lecturer should held a PhD. Thus, a cooperation program between South Ecuadorian universities and the DFG started late in 2009 ("collaboration program") where the Ecuadorian partner designs a research project and pays the PhD student mainly by university research funds. DFG pays a 3 month's stay in Germany of the PhD candidate to visit the co-advisor and for graduation as Dr. rer. nat. or PhD at the German partner university (see **Table 2**).

Scientific Achievements of the RU

The main objective of the RU 816 was to develop a science-directed sustainable land use portfolio that at the same time preserves biodiversity, ecosystem processes and services (functioning), rehabilitates attenuated diversity and lost usability, and guarantees better livelihood for the local population. To reach this aim, a main focus of the program was to compare the ecosystem services of the undisturbed ecosystem "tropical mountain forest" with those of its anthropogenic replacement systems, pastures and abandoned pastures, but also sustainably used natural forests and tree plantations. Likewise important was the question of the main impacts of ongoing changes on the biodiversity and ecosystem services in the study area and how the developed sustainable land use systems must be shaped in order to preserve central ecosystem services under the pressure of a changing environment.

The results of the whole endeavor and the synthesis of our joint research within the RU is currently summarized in a book to be published in the "Ecological Studies" Series from Springer. The book explains mostly on the basis of quantitative data,

Figure 5: Bracken invades the slopes (grayish green colors) after slash and burn in the Reserva Biologica San Francisco (RBSF) area following an uncontrolled fire. The remaining pasture grass appears in bright green. Photo: J. Bendix

how ecosystem functions and services at all levels are affected by environmental changes by different mechanisms and to different extents.

Impacts of Climate Change

Climate change will most likely result in an on-going warming while changes in precipitation turned out to be highly uncertain. This imposes different potential impacts on ecosystem services. Uncertainty in rainfall projections may pose several threats on ecosystem services, depending on the mathematical sign of the considered anomaly. Droughts would negatively affect supporting services as e.g. leading to a reduction of soil organisms and nutrient turnover rates. At the same time reduced waterlogging of soils in the upper forest and the Páramo zone would cause an increase of nutrient turnover. A surplus of rainfall on the other hand could enhance water logging of the soil and in turn the risk of landslides. The change towards e.g. more heavy rains would negatively affect the nutrient balance by an increase of ion leaching.

Impacts of Nutrient Depositions

The second major threat results from atmospheric nutrient deposition originating from remote sources (mainly Amazon biomass burning). It will accelerate the carbon turnover rate, stimulate tree growth and thus change the carbon regulation function of the natural forest. But an increased of above ground biomass production will also increase the risk for landslides, which impact on biodiversity, carbon and nutrient/sediment cycles. Protons in the atmospheric depositions stress the buffering capacity of the soil, resulting e.g. in a dramatic acidification and lack of cations. Regarding agricultural provisioning services atmospheric fertilization is not sufficient to replenish deficient nutrients in the impoverished soils but nevertheless fosters carbon turnover rate. Expected negative ecological effects of remote fertilization are e.g. changes of the community structure of the soil organisms as the mineralization compartment of the ecosystem.

Impacts of Land Use Changes

Land use change, the main ongoing threat to the study area, leads to a loss of biodiversity (supporting services) and an alteration (often deterioration) of soil structure, chemistry and biology. Exceptions are arbuscular mycorrhizal (AM) fungi and special groups of soil organisms, e.g. testate amoebae, which survive slash and burn or re-colonize the new habitat. An enhancement of microbial biomass is accompanied by a shift in species composition due to an increase in nutrient supply after burning of the area. Altogether, current land use change was found to destabilize ecosystem functioning and services. Provisioning services in the converted areas can only be maintained by permanent management as e.g. fertilization, cattle grazing and weeding over a reasonable period of some decades.

Impacts of Invasive Species

Regarding the threat of the pasture as anthropogenic replacement systems of the forest, invasive species are one reason for their instability. In an ecological view the commonly used exotic pasture grasses *Setaria sphacelata*, *Melinis minutiflora*, *Pennisetum clandestinum* compete with an invasive species (southern bracken) which follows recurrent slash and burn activities to remove the natural forest and to periodically rejuvenate the pastures (**Figure 5**). Especially in nutrient depleted soils, bracken outcompetes the grasses, thus negatively affecting the provisioning services of the pastures.

Even if in such a complex system as the study area the gained knowledge is far from providing a full and detailed understanding of the manifold interactions and feedbacks between the different service levels, the results prove that the current agricultural provisioning services are ecologically not sustainable. In

contrast to that the natural forest has proven as a remarkably stable ecosystem with a high resilience against environmental change. As a result, especially the agricultural ecosystems and their provisions are under risk of environmental change which needs mitigation strategies towards a more sustainable and resilient land use system.

Sustainable Land Use Portfolio

Such a land use portfolio for the mountain rain forest of Ecuador must therefore encompass:

- A sustainable agricultural intensification; paired with
- land use diversification as a risk reduction strategy; complemented by
- (external) compensation payments for forest conservation.

From our findings, a suitable and sustainable land use portfolio for the mountain rain forest of southern Ecuador should combine a higher pasture yield by means of fertilization and bracken control which halts the pressure to clear new natural forest. Intensification means also carefully using parts of the natural forest by extracting timber and collecting non-timber products, as well as including other sustainable land use alternatives as e.g. specialized sustainable systems as practiced in indigenous home gardens. Conservation of sufficiently large parts of the natural forest is a major pillar of a sustainable management portfolio which helps to maintain ecosystem services of the whole system. To reach a sufficient conservation level an improvement of the livelihood of the local population is needed. This should be fostered by equalization payments for carbon regulation services and watershed protection. Restoring abandoned agricultural areas are another component of the sustainability portfolio which potentially will reduce the pressure on the natural forest.

Jörg Bendix & Erwin Beck
Speaker & Deputy Speaker of the RU

References

[1] The State of the Planet Declaration, pdf file available at: http://www.planetunderpressure2012.net/pdf/state_of_planet_declaration.pdf. The research initiative Future Earth at the website of International Council for Science: http://www.icsu.org/future-earth.

[2] English summary of the agreement: http://www.dfg.de/download/pdf/dfg_im_profil/im_internationalen_kontext/partner/agreement_dfg_senescyt_en.pdf German texts: http://www.kooperation-international.de/detail/info/abkommen-zwischen-dfg-und-senescyt-ueber-die-wissenschaftliche-zusammenarbeit-zwischen-deutschland-u.html and: http://www.dfg.de/dfg_profil/im_internationalen_kontext/internationale_partner/Ecuador/index.html.

News from the ECSF

Visiting Delegations from the City of Cuenca and from ETAPA

At the 29th of August 2012 a delegation from Cuenca headed by the councillors Dr Wilson Muñoz and Joaquín Peña and the Chief Executive Officer of ETAPA, Oswaldo Larriva, visited the ECSF (**Figure 6**). ETAPA (Empresa de Telecomunicaciones, agua potable y alcantarillado de Cuenca), the company which provides municipal services for Cuenca and its surroundings, is an important cooperation partner within the future joint research platform. The idea was introduce the RU and the Estación Científica San Francisco (ECSF) research station to the visitors. After a presentation about the accomplishments of the present RU and the aims of the planned research platform a short tour in the ECSF ares was conduced. Subsequently, ideas about the future cooperation where discussed.

Loja Airport Closed Until November

The airport of Loja remains closed at least until middle of November this year. Detailed, up to date information also about the alternatives can be found at our website at TropicalMountainForest.org

Jörg Zeilinger
Station Manager

Figure 6: Oswaldo Larriva (center with hat) and the councilors Dr Wilson Muñoz (left of Larriva), Joaquín Peña (right of Larriva) together with Alfredo Martinez (Director of the Cajas National Park, right), representatives of NCI, the press and the scientific coordinators of the RU visited the research station. Photo: Pablo Guaman, ETAPA

News from NCI[1]

NCI's Laipuna Reserve is Awaiting the Start of Research

The Laipuna Natural Reserve is located 150 kilometers southwest from the city of Loja in the Macara County close to the Peruvian border (see **Figure 7**). It is part of a bigger area of several thousand hectares in a good conservation state that extends downstream along the Catamayo canyon, including a part in Peru. The Reserve area has been recognized as the first conservation priority by the governments of both countries and can be considered as one of the best remnants of this kind of forest in the Tumbesian Region (cf. **Figure 8**).

The altitudinal gradient at the reserve ranges from 480 to 1500 meters above sea level which gives the area special conditions. It's attractive because it harbors plant and animal species both from the dry and humid upper forests. Since Nature and Culture International (NCI) acquired the area ten years ago it was fenced and cattle farming stopped.

In the last months NCI has started the improvement and construction of new research and accommodation facilities. This includes installation of the electricity system, construction of a new accommodation facility, bathrooms, and the maintenance of the current infrastructure. The access to the new research station was improved as well and solutions to access it during the winter season were discussed. The research paths will be improved in cooperation with the scientists and their demands.

Figure 8: The Catamayo river runs through the Laipuna Reserve which is home of deciduous trees. The dry forests are highly biodiverse, with many endemic species. Photo: NCI

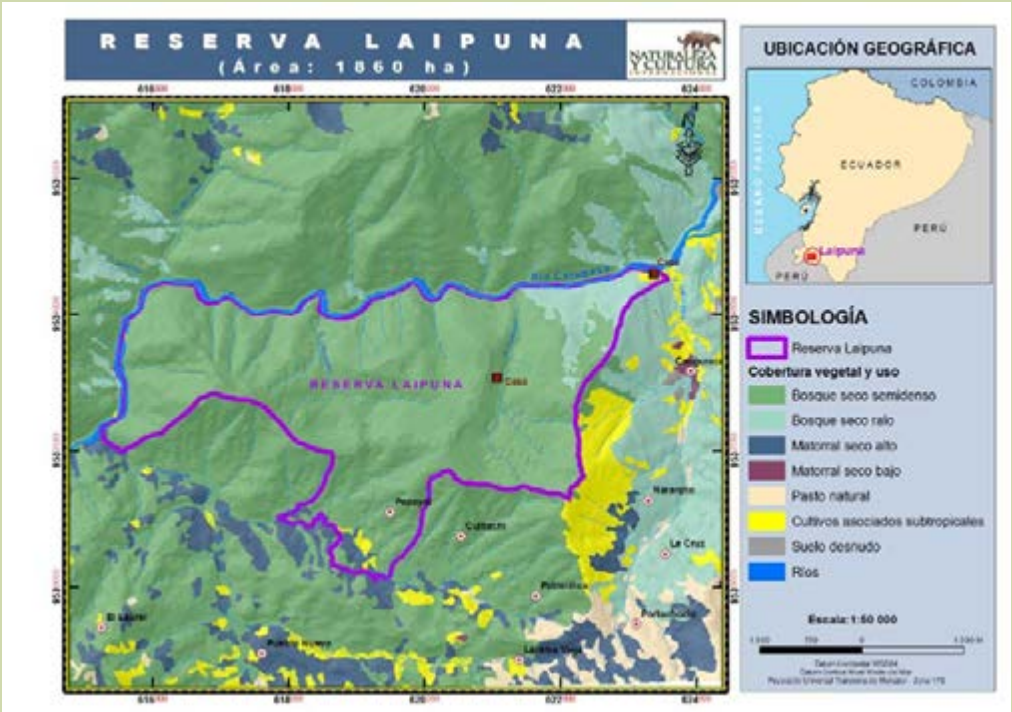

Figure 7: The Laipuna Natural Reserve comprises 2,000 hectares of deciduous dry forest and is located at the upper Catamayo River. Map: NCI

Figure 9: The President of the Commonwealth of Dry forest (left), Ramiro Valdivieso, signs the agreement during the solemn session held by the Municipality of Zapotillo to celebrate 32 years of the county's border jurisdiction. Renzo Paladines, NCI's executive director (right), observes the scene as well as the people in the audience. Photo: NCI

Five Municipalities and NCI Cooperate to Declare a New Biosphere Reserve

On August 27th, 2012, Ramiro Valvivieso (**Figure 9**), mayor of Zapotillo and president of the Commonwealth of Municipalities in Southwestern Province of Loja signed a specific agreement of inter-institutional cooperation with NCI. The Commonwealth of Municipalities in Southwestern Province of Loja - also known as the Commonwealth of the Dry Forest - is formed by the Counties of Celica, Macará, Pindal, Puyango and Zapotillo. The agreement between the Commonwealth and NCI aims to promote the declaration of a biosphere reserve officially recognized by UNESCO under the jurisdiction of the five Counties that make up the Commonwealth. The reserve comprises an area of approximately 320,000 hectares of deciduous forests.

The cooperation came to life some time ago when these Municipalities recognized their territory as an ideal geographical space to be recognized by UNESCO as a biosphere reserve. This would be a magnificent opportunity for comprehensive sustainable development and management for conservation of natural and cultural heritage present in the mentioned Counties, and for the inhabitants, with the goal to improve their quality of life.

[1] In this section Nature and Culture International (NCI, www.natureandculture.org) introduces its activities and reports recent progress. NCI is a non-governmental organization whose mission is to assist in the conservation of biological and cultural diversity.

First Transfer Project[2]

Good Seed Quality is the Reward for Trained Climbers

In a course nursery workers trained how to use climbing harnesses and carabiners to improve seed collection for aforestation research.

It was the heading of a major national Ecuadorian newspaper in one of their daily sections referring to a training course directed to climb trees for collecting seeds. It was organized by the Transfer Project forest "Nuevos Bosques para Ecuador" sponsored by the German Research Foundation (DFG) and carried out between April 16th and 27th 2012. The Provincial Government of Loja (GPL), Nature and Culture International (NCI), local Universities (UNL and UTPL), Ecuadorian Red Cross and the National Institute of Agricultural Research (INIAP)

Figure 10: Ropes and snaprings safeguard one of the participants who climbs a tree. Photo: Baltazar Calvas

[2] Transfer projects are spin-offs of the RU and aim to apply the knowledge gained from scientific research. Like the RU they are funded by the German Research Foundation (DFG).

Figure 11: Seed harvesters are now able to collect seeds which they couldn't reach in the past. Photo: Baltazar Calvas

were the main institutions involved. Restless and eager were the first reactions among over 20 participants, who qualified as nursery workers and work in activities related to seed collection in the field between the Province of Loja, Zamora Chinchipe and Pichincha. They readily learned the procedures and the handling of the new equipment and climbing materials.

The attendees usually climbed trees without any kind of safety equipment. Due to a sense of insecurity and fear of falling from the treetops, they were never sure neither of the quality nor the quantity of seeds they were able to collect or even whether they would be able to collect any seeds at all. Most of the participants came to the conclusion that at first it was a challenge to use the new equipment (**Figure 10**). But the instructor's experience and his training abilities provided them with a sense of security.

Currently the equipment acquired by our Transfer Project will be given to the different local institutions that were trained. We soon will establish an institutional loan system for seed collection, depending on the needs of the institution and the dates of collection, dates which depend on the phenological calendar developed and assembled previously. Alfred Woerle, the German trainer, said he was impressed by the learning capacity of the students since he finds it challenging to climb such large trees that are so different from the ones he is accustomed to climbing back in Europe (**Figure 11**).

Thus the transfer project has started its outreach activities, support for forest areas in southern Ecuador and has created great expectations especially in regards to interlinking the local institutions with the conservation of natural resources.

Baltazar Calvas, Bernd Stimm, Reinhard Mosandl, Sven Guenter, Eduardo Cueva & Patrick Hildebrandt

Second Transfer Project

Towards a Weather Radar Network of South Ecuador

Recently the second RU knowledge transfer project spin-off was approved. It's methods, aims, and the involved people and institutions will be introduced.

The Need to Monitor and Forecast Water Input

Water is one of the most important resources of Ecuador. A great part of the country's power supply (~70%) is generated by hydro power plants. Furthermore, the potable water supply of the Ecuadorian cities and the provision with irrigation water for agriculture in drier areas (as the dry forest areas in southern Ecuador) relies on the water sources of the Andes high mountains. This also holds for southern Ecuador. To properly manage water resources its is of utmost importance to monitor and forecast the atmospheric water input by precipitation in time and space. Unfortunately, the official network of meteorological stations particularly in southern Ecuador is too scarce to provide reliable rainfall data. Furthermore, meteorological stations are hardly existing in the high mountains of Ecuador, the main source of water. Also the temporal resolution of station data including data submission is not sufficient for a use in hazardous weather warning and disaster prevention systems where e.g. the nowcasting of heavy rains, its possible modifications in the scope of climate change, and resulting flash floods frequently causing landslides and damages of infrastructure (roads) in the Andes is a major task of the regional and the national administration.

In developed countries, weather radar networks normally provide spatio-temporal data for precipitation nowcasting. However, in the Andes of South America, no radar network hitherto exists. This is (i) due to the high costs of scanning radar systems and (ii) problems with radar shadows and thus radar calibration in complex mountainous terrain as the Andes.

In the RU816, a technique has been developed, tested and validated to properly calibrate rain radar data in the Andes, based on scanning and cost effective X-band local area weather radar (LAWR) technology which is also affordable by developing countries. The technique uses the radar data to detect the spatio-temporal coverage of rainfall and additional climate stations for converting the terrain-

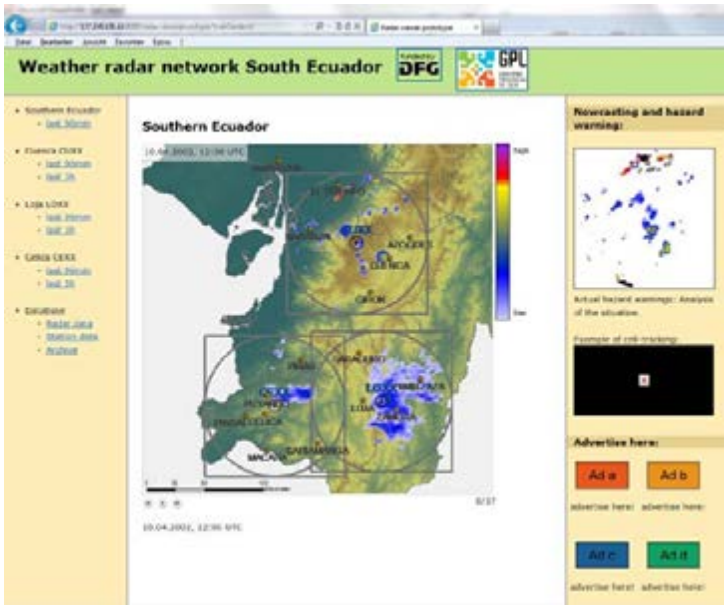

Figure 12: Screenshot of the first test version of the user interface showing the planned positions of the three radars (Loja - right, Celica - left and Cajas - top). Besides the data management system, planned applications are a radar movie for the public and others, a hazard warning section and a convective rain cell tracking as a main severe weather forecast option. The maximum range of a single radar (circles) is 60 km, the highest pixel resolution is 100 m. The color bar beside the radar image shows the magnitude of rainfall derived from radar reflectivity. Screenshot: J. Bendix

corrected radar reflectivity into spatial explicit rain rate data [1] [2].

Project Aims and Consortium

The developed technology was the starting point to apply for the knowledge transfer project “Operational rainfall monitoring in southern Ecuador - towards a rain radar network in South Ecuador” in order to provide the regional authorities with a tool for short-term rainfall and disaster nowcasting, but also for longer-term precipitation monitoring for water resources management, capable to detect impacts of climate and land use change on the water balance. The South Ecuadorian prototype is intended to deliver the blueprint of a national radar network. The main aims of the project are:

- to establish and implement a prototype radar network based on three local are weather radar systems covering southern Ecuador (**Figure 12**)
- to implement real-time data transmission and calibration of the radar images
- to develop a working database (based on RU816dw technology) and a user web interface (**Figure 12**) addressing at the same time the public, the planning administration (in facilitating the official duties mentioned above), and private companies (as particularly water and hydro power suppliers).

The joint development of the prototype was requested to the German Research Foundation (Deutsche Forschungsgemeinschaft, DFG) by an Ecuadorian-German consortium in 2011. The consortium is led by University of Marburg (PI J. Bendix from the current RU816 project D3) and the Provincial Government of the province of Loja (GPL). GPL is situated in Loja, where it’s planning department will implement and operate the central data management and dissemination system). GPL operates the Radar in Celica (CEXX) and works together with several institutions which help in administration, operating and maintaining the systems:
(i) The Technical University in Loja (UTPL) whose staff will operate the Radar in Loja (LOXX) together with GPL
(ii) ETAPA, a company providing municipal services for Cuenca and its surroundings (Empresa de Telecomunicaciones, agua potable y alcantarillado de Cuenca) and the University of Cuenca (UC) who will jointly operate the Radar at Cajas (CUXX)
(iii) the foundation Nature and Culture International (NCI) which supports the setup of the hardware and helps with administrative issues

Further interested bodies are
(a) the Project “reinforcement of the integral management of the binational Catamayo-Chira watershed” (Proyecto Fortalecimiento de la Gestión Integral de la Cuenca Binacional Catamayo Chira)
(b) regional electricity companies (here: Empresa Electrica Regional de Sur S.A.),
(c) the national weather service of Ecuador INAMHI (Instituto Nacional de Meteorologia e Hidrologia), and
(d) the water fund of South Ecuadorian municipalities FORAGUA (Fondo Regional del Agua).

The application was approved by DFG in late 2011, the project has officially started in August 2012 with the employment of the coordinating PostDoc Andreas Fries.

The project is intended to supply spatial explicit rainfall data which also will help to develop biodiversity and ecosystem function indicators in the planned Platform bundle program (see rubric Speakers’ Corner). At the same time, the planned meteorological station network of FORAGUA, ETAPA and Gestion Ambiental Zamora which will be established in the scope of the Platform bundle program might at the same time improve the calibration quality of the radar network significantly.

Project Outline and Current State

Despite the very recent official start of the program, a preparations phase has already brought the project forward since its approval in 2011.

On the Ecuadorian side, an agreement (*convenio*) was drafted and signed among the partners which mutually regulates the rights and obligations of the partners involved. Applications for the frequency permission for the new radars Celica and Cajas are also under way. On the German side, the export of two new radar systems (Celica and Loja) to Ecuador and the import to the country is in work, which needs a lot of paperwork.

At the same time, a first prototype of the Web interface was programmed (**Figure 12**) and the layout for the data managements system is under joint development, with special reference to real-time data transmission and processing (**Figure 13**).

For the installation of the systems in the field, a viewshed analysis was conducted which yielded the most optimal sites for the systems by minimizing problematic areas of terrain clutter and radar shadows in the field of view of the radar systems.

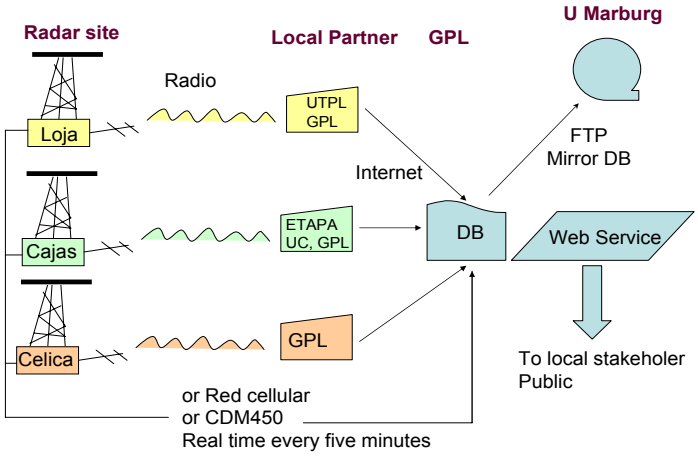

Figure 13: Layout for the data flow in the radar network. Every single radar from Loja, Cajas and Celica will provide an image every five minutes. Data will be sent via radio transmission and/or cell phone/internet to the Provincial Government of the province of Loja (GPL) office and the local cooperation partners (as backup and for further research activities): The Technical University in Loja (UTPL), the company ETAPA, and the University of Cuenca (UC). At GPL office, data will be processed (calibration, inter-calibration, radar movie etc.) and archived in a database (DB). A copy of data and products is sent to University of Marburg (U Marburg) via an FTP-internet connection for backup purposes. GPL hosts the main web services jointly developed as emphasized in the text. Image: J. Bendix

Figure 14: Radar housing for the radar at El Tiro, the mountain range near the city of Loja. The same custom-made housing will also be constructed at the other two radar sites. On the photo, the antenna for the Local Area Weather Radar (LAWR) is installed by two people on top of the radar tower. Photo: A. Fries

At the same time, the concept for a radar housing was developed and already constructed on the first radar site, the pass altitude El Tiro. At this site, the Loja radar was recently installed (**Figure 14**) and is currently under refit.

Jörg Bendix, Rütger Rollenbeck & Andreas Fries (Univ. Marburg), Rubén Bustamante & Giovanny Segarra (GPL), Juan Pablo Suarez & Fernando Oñate (UTPL), Rolando Celleri (Univ. Cuenca), Alfredo Martinez (ETAPA) & Renzo Paladines (NCI)

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Science News - Summarizing Reports of the RU

Nutrient Addition Affects Leaf Parameters and Herbivory

Within the Ecuadorian **NU**trient **M**anipulation **EX**periment (NUMEX, see TMF-Newsletters issues no 13, 8, 2, 1) we compared the effects of nutrient addition on leaf morphology, foliar nutrients and herbivory in common tree species and different plant life forms (project **A1**). At the lower montane forest site we selected four common tree species (*Graffenrieda emarginata*, *Alchornea lojaensis*, *Hieronyma fendleri*, *Myrcia* sp. nov.) in 2011 [1].

In 2012 we sampled common species of other plant life forms and saplings of two tree species in 2012: *Anthurium grubbii* (herb), *Miconia radula* (shrub), *Chusquea* sp. (bamboo), *Elaphoglossum* sp. (fern), *Miconia punctata* (tree saplings) and *G. emarginata* (tree saplings) [2].

In four species specific leaf area (SLA) was significantly increased by the combined addition of nitroigen (N) and phosphorus (P). 70% of the species had significantly higher foliar N concentrations after N or N+P addition. Three of the four studied tree species and the bamboo species showed significantly higher leaf mass losses by herbivory after N addition (see **Figure 15**).

In summary, susceptibility to herbivory after nutrient addition differed between plant species and life forms after 3-4 years of continuous nutrient addition. Accordingly herbivory may be one important mechanism that contributes to changes in the plant composition of forests under increased nutrient deposition [3]. *Jürgen Homeier*

Figure 15: A damaged leaf *Graffenrieda emarginata*, the most common tree species of the San Francisco Reserve. Photo: J. Homeier.

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Effects of Nutrient Additions on Mycorrhizas are Unexpected

Arbuscular Mycorrhizal Fungi (AMF) play an important role as belowground plant symbionts, facilitating nutrient uptake by exploring the soil with an extraradical hyphal network and permitting a direct transfer via specialized structures (arbuscules and coils) within the root cortex [1]. AMF represent the dominant yet understudied mycorrhizal form in tropical forests with special functional and morphological characteristics that are not yet understood. Here, in the framework of the multidisciplinary Nutrient Manipulation Experiment (NUMEX), we test the effect of nitrogen (N) and phosphorus (P) additions on the percentage of root colonization and hyphal length in the soil in order to better understand the symbiosis and its future ecological role under global change (project **A2**).

First results show an unexpected suppressing effect on AMF root colonization after N additions (**Figure 16** next page). This suggests a role of AMF in N uptake in this ecosystem compared to the traditional view that their main contribution is P transfer [2]. These findings must be supported by including effects on AMF biomass in the soil; a challenge considering the characteristics of the tropical montane soil. Following extensive method optimization, we could quantify hyphae in the organic layer, confirming earlier observations that AM hyphae in tropical forests are closely associated with decomposing leaves [3].

In addition to nutrient uptake, AMF play a major role in soil aggregation, a process that improves soil quality and stabilizes soil organic carbon pools [4].

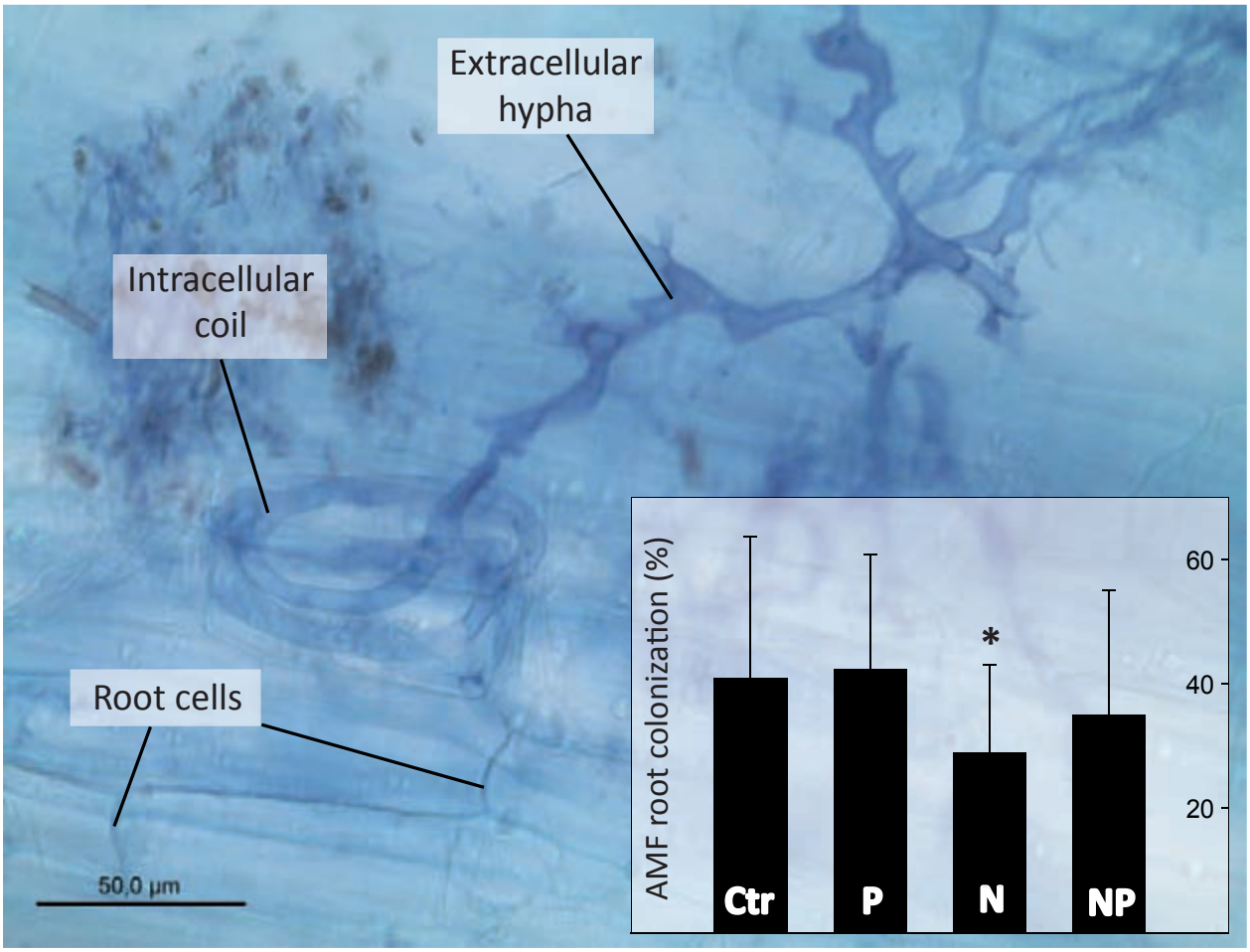

Figure 16: Microscopic picture of a stained root colonized with AMF. Extracellular hypha on the root surface is entering a root cell forming an intracellular coil. The graph illustrates fertilization effects of nitrogen (N), phosphorus (P) and both (NP) on the percentage of AMF root colonization compared to the control (Ctr), in October 2010 at the NUMEX plots at 2000 m a.s.l.. The asterisk * indicates significant differences compared to the control (linear-mixed effect model, "Plot" and "Block" as random effects; $p < 0.05$). Image: Tessa Camenzind, with a microscopic camera (Leica DFC 290)

In the mineral soil at 1000 m a.s.l., we detected an increase in soil aggregation of 20% with enrichment of N and P. However, consideration of explanatory variables reveals an extremely complex picture of interactions, requiring a closer examination of the interplay of biotic and abiotic factors.

Tessa Camenzind & Matthias Rillig

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Responses of Soil Functions and Soil Biota to Nutrient Addition

In the framework of Nutrient Manipulation Experiment (NUMEX) we investigated effects of the addition of nitrogen (50 kg h^{-1} y^{-1} N) and phosphorus (10 kg h^{-1} y^{-1} P) on litter decomposition, microorganisms, micro- and mesofauna. Here we report responses at the site at 1000 m a.s.l. (Bombuscaro-site, project **A3**).

Decomposition of litter of *Cecropia*-trees was significantly increased by N addition ($F_{1,12}$ = 7.65, p = 0.017). However, neither microbial biomass nor the density soil invertebrates responded in parallel (**Figure 17**). Nutrient addition did not significantly affect total microbial biomass, whereas the densities of testate amoebae (live cells) and oribatid mites were significantly increased by the addition of N only, but this increase was annihilated by the combined addition of P and N (N x P interaction: $F_{1,12}$ = 12.37,

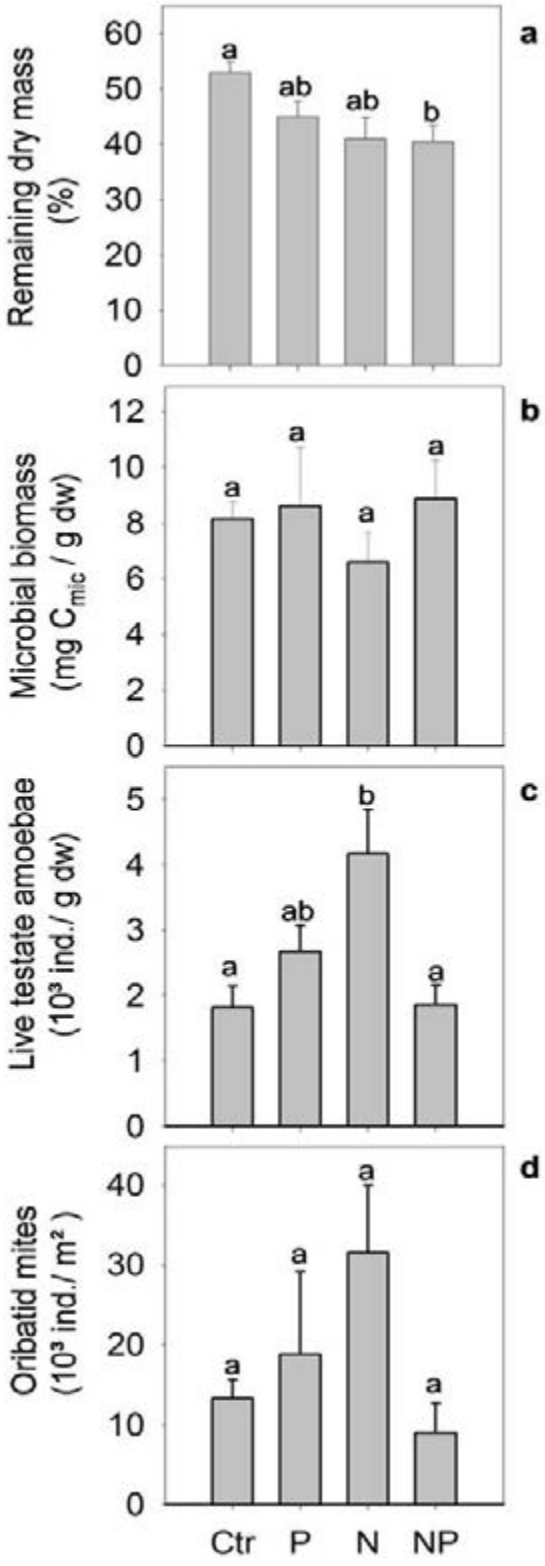

Figure 17: **a)** Response of decomposition of *Cecropia* litter, **b)** microbial biomass (measured by substrate-induced respiration), **c)** density of testate amoebae, and **d)** density of oribatid mites in the L/Oh layer of the tropical montane rainforest at 1000 m altitude (Bombuscaro) to the addition of nitrogen (N), phosphorus (P) and combined nitrogen and phosphorus (NP), Ctr = control without nutrient addition. Significant differences between the means (± SE, n = 4) are indicated by different letters (Tukey's honestly significant difference test). Graphs: V. Krashevska, F. Marian, D. Sandmann, M. Maraun & S. Scheu.

p = 0.004, $F_{1,12}$ = 3.98, p = 0.069, and $F_{1,12}$ = 5.13, p = 0.042 for testate amoebae, total oribatid mites and juvenile oribatid mites, respectively).

The results indicate that increased input of moderate amounts of N accelerates decomposition rates and these effects manifest at short time scales, i.e. after one year. Further, the results suggest that changes in ecosystem functions, such as litter decomposition, are not closely related to the biomass of potential biotic drivers, i.e. microorganisms and microbial consumers, with testate amoebae and oribatid mites representing major consumers of bacteria and fungi, respectively. However, nutrient addition also significantly altered the density of microbial consumers. The strong response to the addition of N indicates that food quality (concentration of N in the diet) is more important than food quantity (amount of microbial biomass) and this is similar in both bacterial and fungal consumers. Annihilation of the beneficial effect of N by additional supply of P indicates that the soil micro- and mesofauna in tropical montane rainforests is not only controlled by nutrients. Rather, interactions of plant roots, mycorrhizal fungi, saprotrophic fungi, bacteria and fauna modify the role of nutrients for soil food web structure and ecosystem performance. It is the challenge of future work to disentangle these interactions.

Valentyna Krashevska, Franca Marian, Dorothee Sandmann, Mark Maraun & Stefan Scheu

Nitrogen Cycling Became Increasingly Inorganic in the Last Decade

In our Long-term Ecosystem Study in Microcatchment 2 (at 1850 - 2150 m a.s.l.), we observed continuously and significantly decreasing contributions of dissolved organic nitrogen (DON) to total nitrogen (N) concentrations in all ecosystem solutions except for stream water from 1999 to 2009 (project **A6**). Kendall's τ in **Figure 18** indicates that the trend towards more inorganic N cycling is most pronounced in rainfall and throughfall, weakens during the passage through the ecosystem and disappears in stream water.

We suggest two major reasons for this observation. The first reason is the increasing deposition of inorganic N, mainly ammonium (NH_4^+) with rainfall which has almost quadrupled in the last decade from ca. 25 mg m^{-2} $month^{-1}$ in 1998 to almost 100 mg m^{-2} $month^{-1}$ after 2008. Increasing N deposition is in line with predictions for the tropics because of increasing industrial and agricultural activities, traffic, and vegetation fires [1]. The deposited inorganic N adds to the pre-existing inorganic N pool which

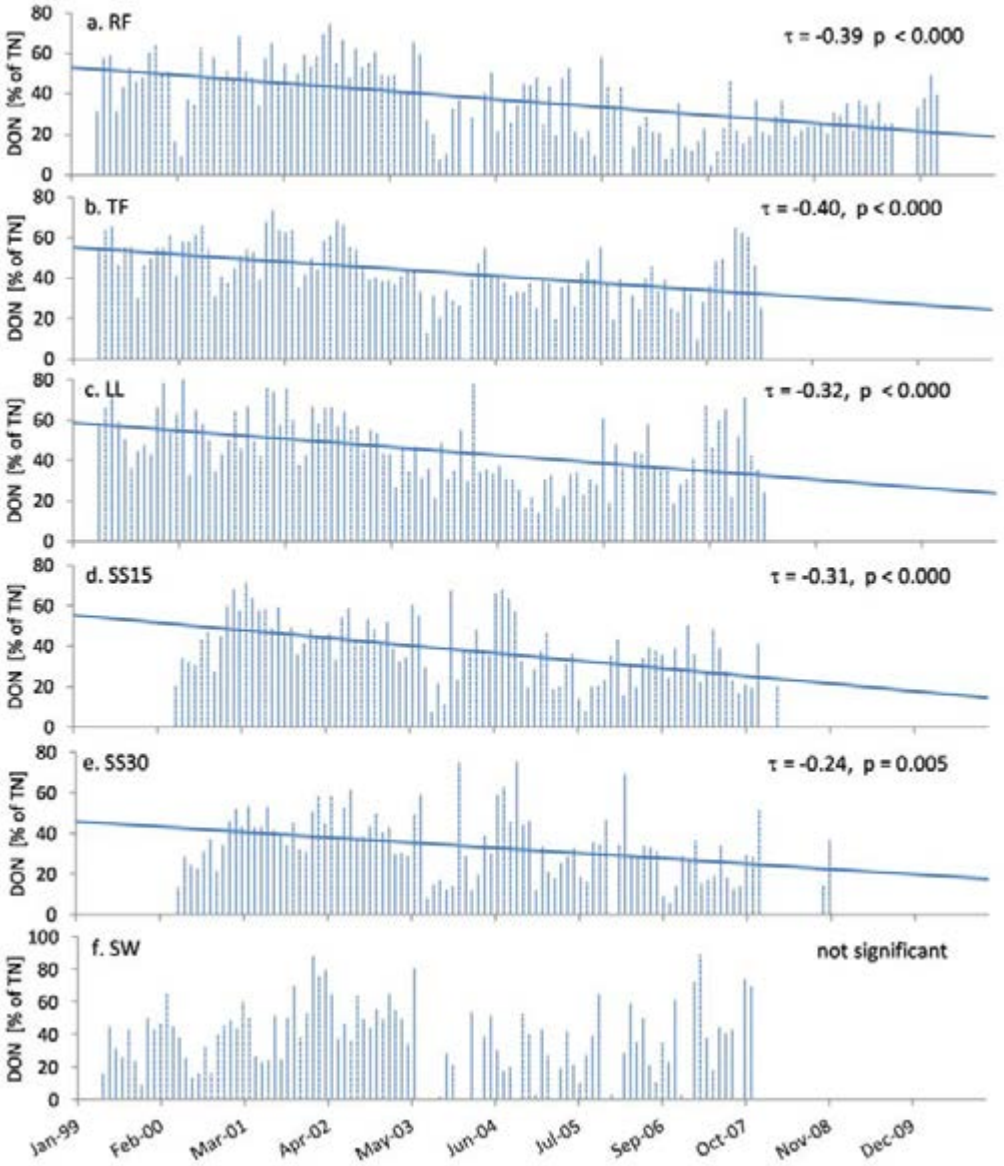

Figure 18: Course of the contribution of dissolved organic N (DON) to total nitrogen concentrations in **a)** rainfall (RF), **b)** throughfall (TF), **c)** litter leachate (LL), **d)** mineral soil solution at 0.15 m depth (SS15) and (e) 0.30 m depth (SS30), and **f)** stream water (SW) between 1999 and 2009. Lines indicate statistically significant trends determined with the non-parametric Seasonal Mann-Kendall test. Graphic: W. Wilcke.

grows relative to organic N. The second reason is that the soil water content decreased between 2000 and 2010 because of climate change. This reduced the times during which N release by organic matter mineralization was impeded because of waterlogging. Consequently, it can be expected that increasingly more inorganic N is released to the soil solution and likely also to throughfall because of soil-like accumulations in the canopy. Both, deposition and enhanced release of inorganic N from soil organic matter by microbial mineralization combine to push the N cycle towards a larger contribution of inorganic N species.

Our results suggest that even very remote ecosystems like our study forest in Ecuador are currently undergoing changes of the N cycling at a fast rate which already occurred earlier in the industrialized temperate zone [2].

Wolfgang Wilcke, Sophia Leimer (Univ. of Berne), Rütger Rollenbeck, Katja Trachte, Jörg Bendix (Univ. Marburg) & Carlos Valarezo (National Univ. of Loja)

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The Competition Between Bracken and Pasture Grass

The Role of Fire

Burning affects the competition between the pasture grass (*Setaria sphacelata*) and the weed bracken (*Pteridium arachnoideum, Pt. caudatum*). Aerial photographs taken in the course of a pasture burning experiment reveal an initial rapid recovery of *Setaria* after the fire, but one year later, the number of bracken fronds had increased significantly (+12%). This result corroborates our earlier findings (project **B1**) on the triggering effect of a heat wave on bracken leaf-bud break [1]. Balloon monitoring maps of leaf area index (**Figure 19**) will be used for model simulations at plot level.

Current State of the Model

Southern Bracken Competition Model (SoBraCoMo) [2] simulations were used for vegetation development scenarios. Following the IPCC A1B scenario[1], productivity of *Setaria* will increase, while bracken will not profit comparably from a temperature rise. A new module for light competition is under construction. The two master students from Osnabrueck (M. Schorsch, J. Knüsting) analyzed the Carbon-Nitrogen (C/N) ratios and photosynthetic efficiency of grass and fern at different altitudes. In contrast to *Setaria* a significant positive correlation of the performance of bracken with altitude was observed (**Figure 20**).

1 The A1B scenario of the *Intergovernmental Panel on Climate Change* (IPCC) is the most likely emission scenario presuming a moderate temperature increase due to a growing world population until the mid-century and a balanced use of energy sources.

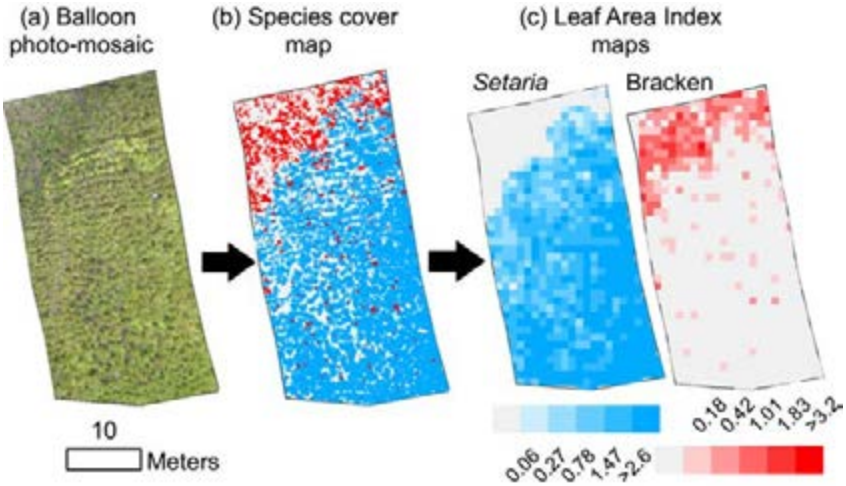

Figure 19: Production of a species cover map (b) and corresponding Leaf Area Index (LAI) maps (c) from an aerial photograph (a). Images: B. Silva

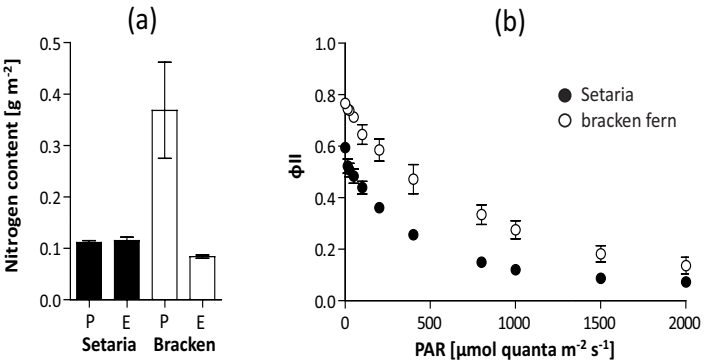

Figure 20: **a)** Leaf nitrogen content and **b)** quantum efficiency of photosystem II (ϕII). Samples for nitrogen determination were taken from pastures at 2000 m a.s.l. (P) and around the ECSF research station at 1800 m (E). ϕII were calculated from chlorophyll fluorescence measurements at pasture site dependent on light intensity. PAR = photosynthetic active radiation. Images: I. Voss.

Pasture Rehabilitation after Bracken Infestation

After intense bracken control followed by planting of *Setaria*, the pasture rehabilitation experiment [3] attained the management phase in which various protocols (low input, intense management) were examined. Grazing stimulated growth of *Setaria* to a biomass production of 0.82 Mg ha^{-1} yr^{-1}, providing fodder for 0.2 heads of cattle per ha. Improving the depleted nutrient status of the soil (analyzed by project **B3**), fertilization combined with grazing stimulated biomass production enormously up to 5.1 Mg ha^{-1} yr^{-1} (allowing 1.1 heads of cattle per ha). A particular advantage of this intense grazing is the enhanced destruction of bracken by trampling, replacing manual bracken control.

Kristin Roos, Brenner Silva, Ingo Voss, Jörg Bendix, Renate Scheibe & Erwin Beck (Universities of Bayreuth, Marburg, Osnabrueck)

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Organic Matter and Microbial Dynamics in Pasture Soils along Management Chronosequences

Project **B3** identified eight chemical and biological soil variables contributing to a significant differentiation of soils along the land-use gradient. These are suitable indicators of soil quality in the ECSF region. Soil properties cluster according to the three groups: pastures, abandoned/re-established pasture and shrubland/forest (**Figure 21**). Within the pasture cluster, especially the higher contents of extractable organic phosphorus (P) and the higher gross nitrogen (N) mineralisation activities of soil microbes differentiated the 17 yr-old pasture from the others. Along the chronosequence nutrient depletion is crucial for microbial activity and soil quality [1, 2]: in the pasture cluster first P depletion appears. Between the pasture and abandoned/re-established pasture cluster N depletion is more obvious and proceeds in mineral topsoils of shrubland sites. Although the shrubland site (a former pasture that has been abandoned about 20 years ago due to severe bracken-infestation and subsequent succession of herbaceous and shrubby plant species) clustered close to the forest (**Figure 21**) one important soil property, the C/N ratio, was significantly wider. *Ute Hamer & Alexander Tischer*

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Silvicultural Studies to Promote Sustainable Forest Management

Deforestation and conversion to agricultural land-use is still ongoing mainly due to a low profitability of forest management. Moreover, degraded and abandoned areas are emerging as a consequence of unsustainable land-use. Improved silvicultural knowledge is needed in order to enhance the sustainable management of natural forests and the restoration of abandoned areas. Therefore, various in-depth studies on natural forest dynamics (repeated inventories on 13 ha), on the effects of silvicultural interventions on tree growth and a comprehensive monitoring of phenology (450 trees of 9 species under monthly observation) have been executed (project **C1**). Natural succession on abandoned areas, the development of planted native and exotic tree species and the effect of grass competition (rhizotron experiments; **Figure 22**) have been investigated [1].

Preliminary results of the recent rhizotron experiment showed that above- and belowground biomass allocation of trees is lower with grass competition and tree root development seems to be

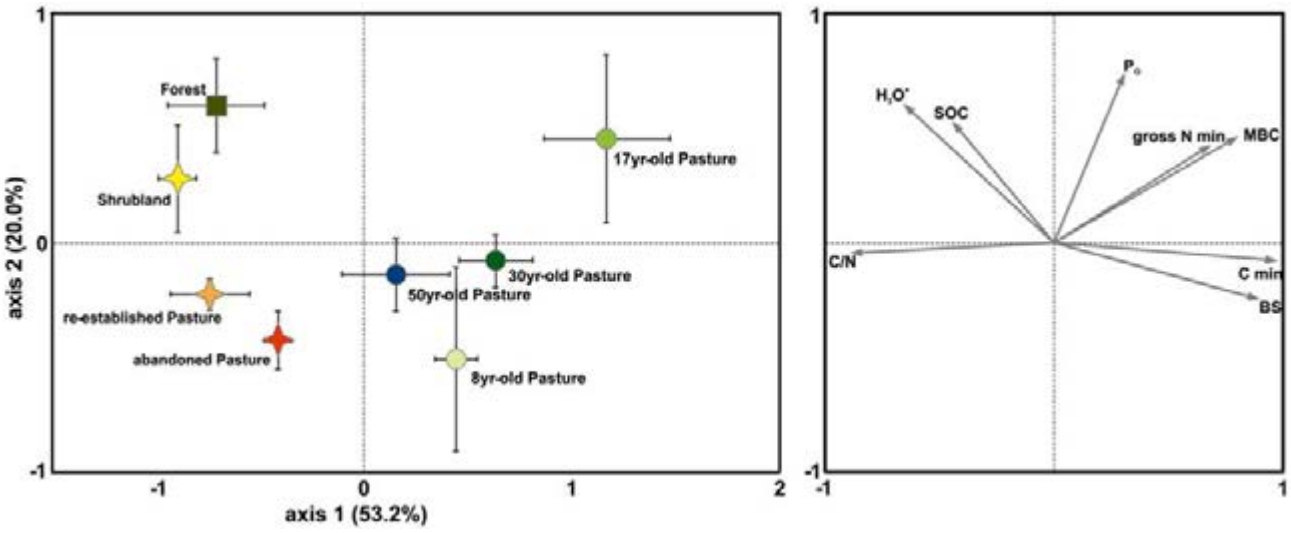

Figure 21: Correlation biplot of a principal component analysis (PCA) for soil chemical and biological variables along the land-use gradient (mineral topsoil, 0-5 cm). This linear ordination method reduces the multidimensional dataset into a set of hypothetical environmental gradients. Variables (C/N = C/N ratio, $H_3O^+ = 10^{-pH(H2O)}$; SOC = soil organic carbon, P_O = organic P_{Bray}; gross N min = gross N mineralization rate; MBC = microbial biomass carbon; C min = C mineralization rate; BS = base saturation) were normalized prior to the ordination procedure. Symbols represent mean (n = 5) and bars SD. Both axes account for 73.2% of the variation within the data set and visualize the dissimilarity structure for the samples and variables. Image: U. Hamer & A. Tischer

Figure 22: Monitoring the effects of root competition in rhizotron experiments with native trees of *Alnus acuminata*, *Cedrela montana*, *Juglans neotropica*, *Heliocarpus americanus*, *Tabebuia chrysantha*, exotic *Pinus patula* and *Setaria sphacelata* as grass competitor. Photo: Julio Mora.

suppressed. The development of the tree species *Alnus acuminata* and *Juglans neotropica* with grass competition was more successful compared to the other considered species which suffered a stronger effect on biomass allocation.

A direct seeding experiment with four tree species demonstrated their potential of germination and survival under diverse conditions. Mean germination rates of *A. acuminata*, *Cedrela montana*, *Tabebuia chrysantha* and *Pinus patula* were promising, but mortality was also high (**Figure 23**). The rate of surviving seedlings seems satisfying in the case of *C. montana* on both sites; *P. patula* showed site specific results and *T. chrysantha* seedlings are almost completely lost on both sites. *A. acuminata* germination and survival is better than expected, but the monitoring period is still not completed in this case.

Both experiments provide a more detailed knowledge of different possibilities for reforestation of abandoned areas. Moreover, the results of our investigations serve for the development of concepts for restoration, sustainable forest management, and sustainable land-use [2-3].

Patrick Hildebrandt, Daniel Kübler, Julio Mora, Ximena Palomeque, Michael Weber, Bernd Stimm & Reinhard Mosandl

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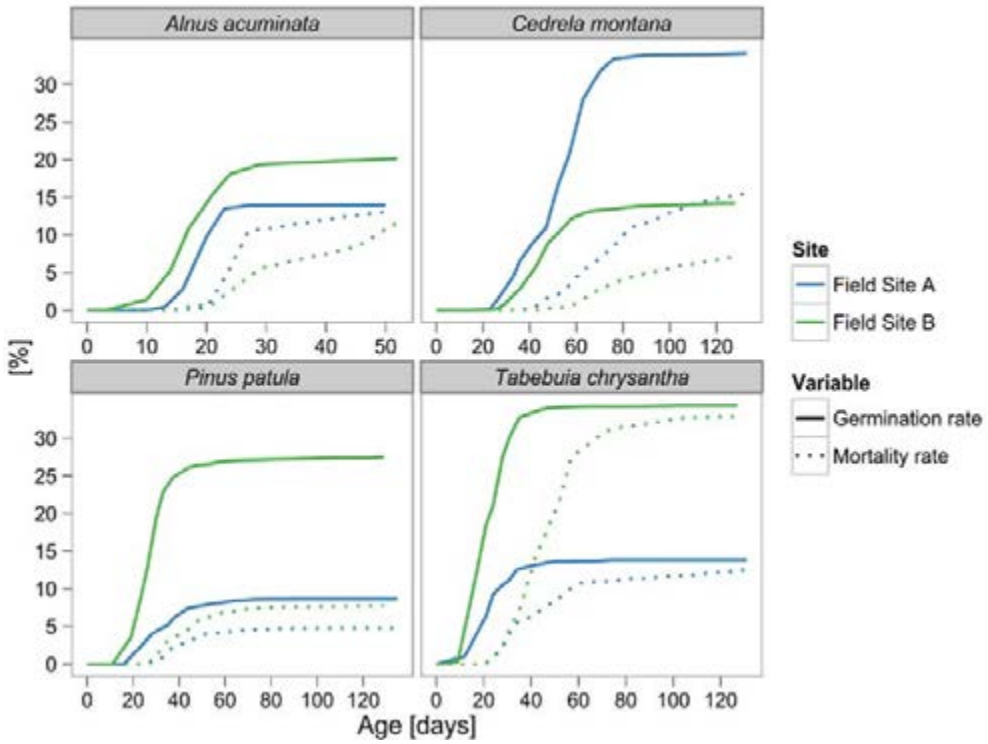

Figure 23: Germination and mortality rates of *A. acuminata*, *C. montana*, *P. patula* and *T. chrysantha* after direct seeding on two field sites. Image: D. Kübler, P. Hildebrandt

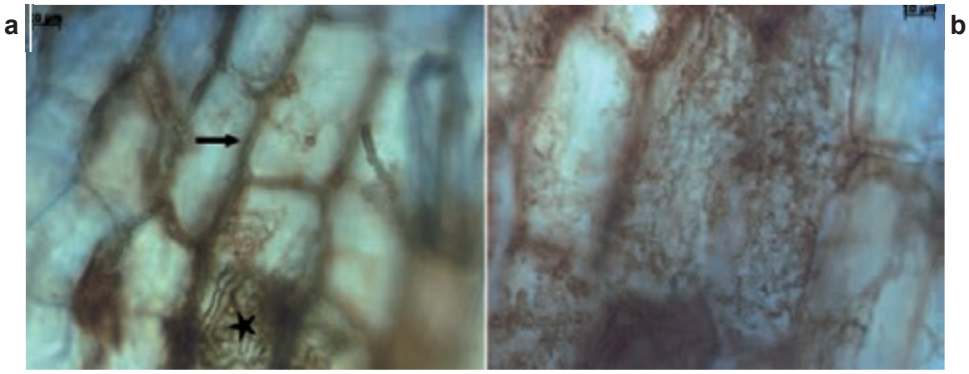

Figure 24: Superficial light microscopical view of the hyphal layer on the surface of the rhizodermis of *Graffenrieda harlingii* rootlets. **a)** Hyphae line the cell junctions (arrow) and spread over the cell surface (star); **b)** Hyphae on the cell surface, multibranched, in close contact. Scale 10 µm. Image: L. Münzenmayer.

Dual Mycorrhizal Colonization of *Graffenrieda harlingii* trees

Former studies [1] revealed that the rootlets of *Graffenrieda emarginata* (Ruiz & Pav.) Triana (Melastomataceae), a frequent tree species on the mountain ridge and upper slopes between 1800 and 2400 m in the Reserva Biologica San Francisco (RBSF) region, are symbiotically associated with arbuscular mycorrhizal fungi and simultaneously form ectomycorrhizas displaying a superficial Hartig net but no hyphal mantle. We investigated the rootlets of *Graffenrieda harlingii* Wurdack, a characteristic species of the upper montane forest [2]. In project **C2** root samples were collected from five trees along the T2 ridge at ~ 2500 m a.s.l..

A brownish, net-like fungal layer is visible covering the fine roots partly. Surface views from light microscopy show labyrinthic growth of a darkly pigmented, septate fungus (**Figure 24 a, b**). The hyphae first follow the cell junctions and spread from there as multibranched structures over the rhizodermis (**Figure 24 a, b**). Colonization of cortical cells by arbuscular mycorrhizal fungi was consistently observed in stained rootlets.

Molecular analysis revealed a multitude of Glomeromycota and Ascomycota. Molecular phylogenetic studies provided evidence for the same identity of the ectomycorrhizal symbiont as for *Graffenrieda emarginata*: The sequences cluster together with the ectomycorrhizal sequences of *Graffenrieda emarginata* in the *Rhizoscyphus ericae* aggregate (Ascomycota). Preliminary results of the arbuscular mycorrhizal fungi of *Graffenrieda harlingii* revealed Glomeraceae and Acaulosporaceae, also proven for other tree species in the RBSF region (*G. emarginata, Alzatea verticillata, Hyeronima moritziana, Cedrela montana, Tabebuia chrysantha, Clusia elliptica, Prunus cf. opaca, Podocarpus oleifolius*), confirming the unspecificity of the arbuscular mycorrhizal fungi. The dual mycorrhizal state of *G. emarginata* and *G. harlingii* is considered crucial for its competitiveness and abundance in these sites.

Ingeborg Haug, Lisa Münzenmayer & Jürgen Homeier

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Payments to Conserve Biodiversity and Carbon Storage

Often, less profitable land-use practices or land covers provide important ecological/social values, which are not acknowledged by markets. For example, agroforestry systems, such as shade coffee (**Figure 25**), harbor great biodiversity, but are converted to maize croplands for financial reasons. Natural forests provide not only high biodiversity, but also store enormous carbon, which is to be seen as an important ecosystem service to regulate our climate. Despite these obviously valuable issues: the agricultural/rangeland frontier is continuously expanding into natural forests and other biodiversity friendly ecosystems. Existing approaches to derive conservation payments for convincing farm-

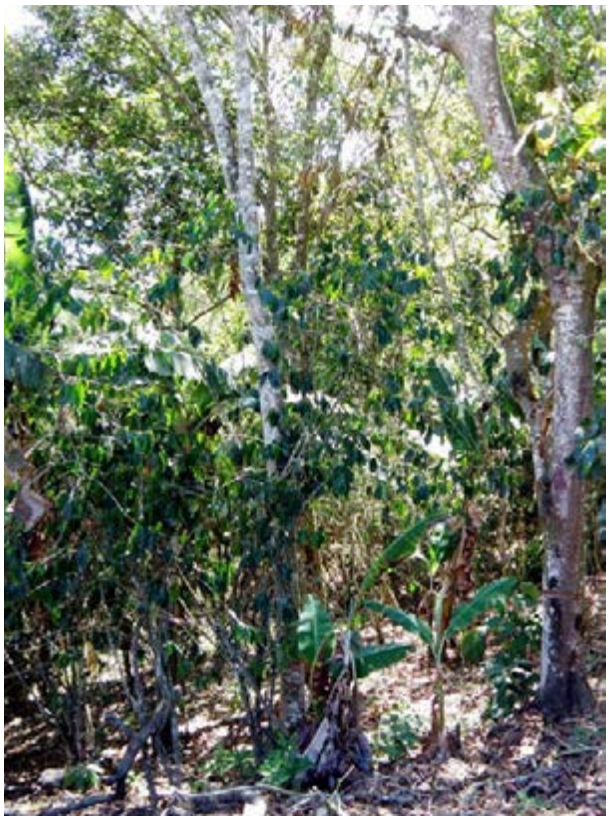

Figure 25: The main species is shaded coffee (*Coffea arabica*), 6 meters tall and 10 years old, without pruning or any kind of management, associated with banana plantain (*Musa paradisiaca*). Photo: LM Castro.

ers to maintain ecologically valuable land-use options/land covers come up with very high necessary payments, because they consider land-use options mutually exclusive. In contrast, new approaches in project **C3** [1-3] allow for diversified land-uses (including profitable agricultural options) resulting in considerably smaller necessary conservation payments. For example, Castro et al. [1] showed that US$ 40 per hectare per year could already save 75 % of shade coffee areas under specific circumstances. The new approaches provide suggestions for improved allocation of land to considered land-use practices and thus support more realistic conservation strategies.

Thomas Knoke, Luz Maria Castro, Baltazar Calvas & Patrick Hildebrandt

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The Shuar's Traditional Resource-Use System Under Threat: Colonization Pressure in the Alto Nangaritza

Land Use and Land Cover Change

In the East of Podocarpus National Park the agrarian colonization process is progressively moving southwards along the Alto Nangaritza and its tributaries (**Figures 26, 27**). The colonists (*Colonos*) are mainly mestizos, and Saraguros from the Yacuambi Valley. They clear vast areas of forest to establish extensive pasturing, threatening local biodiversity and affecting the traditional resource-use system of the Shuar (hunting grounds, water contamination).

The Shuar's Traditional Livelihood Under Threat

In 2011 in project **C4** a livelihood survey (modified from [2]) was conducted in 45 Shuar households of two communities. Like other Amazonian ethnic groups, Shuar livelihood is still mainly based on shifting cultivation (27), fishing, hunting, and gathering. The forest is of great relevance to them and provides them with almost all basic needs [3, 4]. However, more and more Shuar are integrating into the market economy. Although monetary income mainly stems from the selling of food crops [*naranjilla* fruit (*Solanum quitoense*), banana/plantain (*Musa* spp.), cassava (*Manihot esculenta*), sweet potato (*Ipomoea batatas*), taro (*Colocasia esculenta*), cacao (*Theobroma cacao*)], 7 households re-

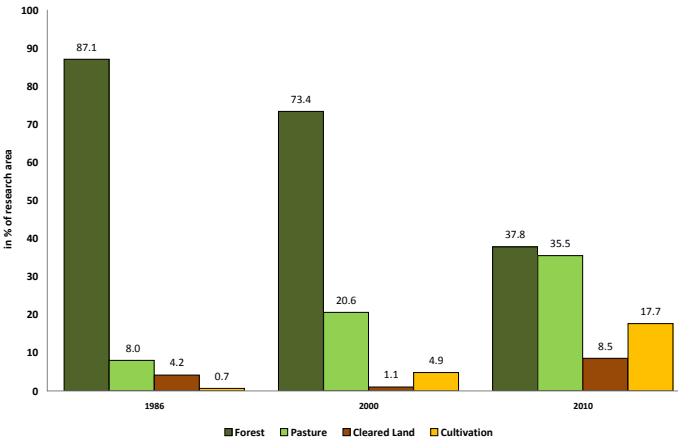

Figure 26: Land use / land cover change detection along the Alto Nangaritza and the Rio Numpatakaime. According to aerial photo and satellite image (RapidEye) interpretation [1] the tropical forests were reduced in 2010 to almost half the area covered in 2000, the pasture area increased by 15% and the cultivated area by almost 13%. The research area encompasses 6717 ha in total and stretches one kilometre west and east from the Rio Nangaritza between the villages of Las Orquídeas in the North and Selva Alegre in the South as well as along the Rio Numpatakaime until Nuevo Paraíso in the South. Graphic: P. Pohle 2012

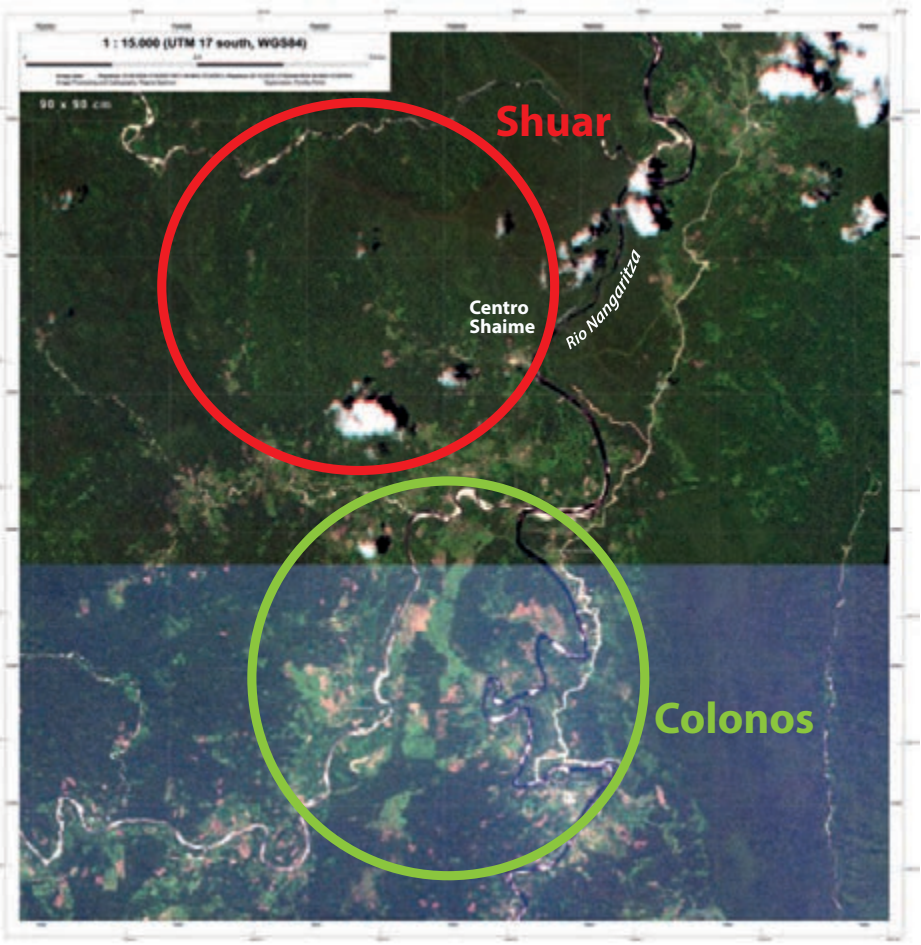

Figure 27: Shuar (red) and Colonos (green) territories reflect different resource-use strategies and in consequence cultural landscapes: the Shuar territories are characterized by the dominance of forests with small scattered shifting cultivation plots of manioc and plantains; the Colonos territories show pasture areas with forest fragments (RapidEye 2009/10 Alto Nangaritza: light green = pastures, brown = recently cleared forest). Image processing: R. Spohner

ported cattle ranching as the main income source, and 6 households named timber logging.

Along with the livelihood survey a stress perception survey was undertaken. The main environmental stressors mentioned by the Shuar were “less fish in the rivers” (33), “less trees and plants” (28), “less game for hunting” (27), and “small-scale mining in the rivers” (24). The latter is a controversial issue since the prices for gold were rising dramatically along with the global financial crisis, encouraging even very small-scale gold mining activities along the Nangaritza. Regarding socio-economic aspects, “problems with the intermediaries” (34), “lack of land for future generations“ (31), and “no agricultural extension service” (27) were the main points of concern.

Conclusion

Recent agrarian colonization puts high stress on the Shuar’s traditional forest and biodiversity conserving resource-use system, especially by reducing available land. Preserving tropical forests clearly means protecting traditional Shuar territory and recognizing the environmental services of forest-dependent peoples (**Figure 27**).

Perdita Pohle, Andrés Gerique, María Fernanda López & Viviana Buitrón

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Advances in Climate Change Research of the Study Area

Project **D3** aims to understand the effects of global change (local land use change and global climate change) on the local and regional climate of the study area. The effects of local land use change, particularly deforestation to gain pasture land, was examined by comparing gridded climate data sets of both land cover manifestations. It could be shown that the climate (thermal and vapour) regulation function is degraded by a conversion from natural forest to pasture [1]. A precondition for future climate projections is a regional climate model properly adjusted to the complex study area. The proper adjustment of the Weather Research and Forecasting (WRF) model in a spatial resolution of 36 km is conducted by comparing the current climate conditions (2000-2009) with simulated data.

The ability of WRF to represent the main thermal characteristics of the study area could be generally proven (**Figure 28b**). However, the bias between WRF rainfall simulations and the Tropical Rainfall Measuring Mission (TRMM) control data (**Figure 28a**) points to an underestimation of the model in the northern Amazon, but in most regions and especially over the Andean mountains, WRF generates an overestimation of rainfalls.

A comparison of the modelled monthly rainfall amounts with observational values at the ECSF research station shows similar results (**Figure 28b, bottom**). The monthly mean air temperatures at 2 meters describe a good agreement between the WRF output and the observations (**Figure 28b, top**). At the beginning of the decade WRF temperatures are below the measurements, but almost fit for the following years. It should be stressed that despite the overestimation of precipitation WRF reproduces the annual variability of both climate indicators.

With a refinement of the horizontal resolution from 36 km to 12 km grid size we suggest an improvement of the simulation results due to a more accurately represented terrain [2].

Katja Trachte, Rütger Rollenbeck & Jörg Bendix (Univ. Marburg)

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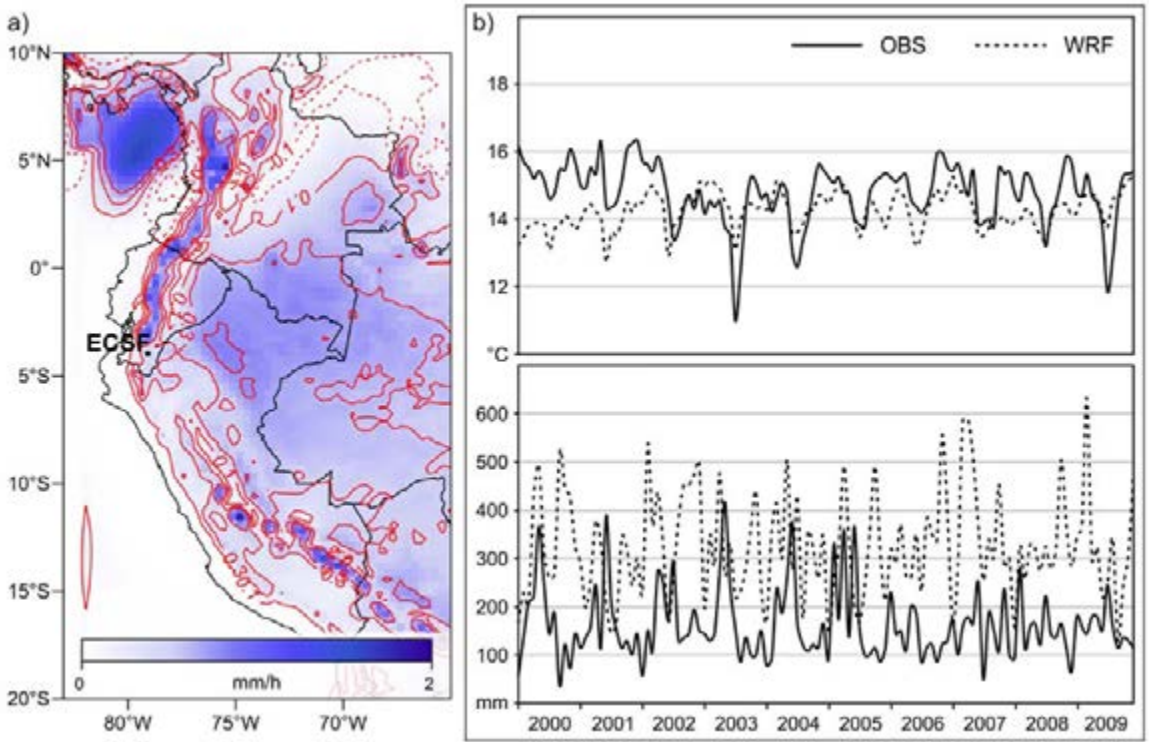

Figure 28 a) Mean precipitation rate (mm h^{-1}, shaded) of WRF model run and bias between WRF and TRMM precipitation rates (red contour, solid indicates an overestimation and dashed an underestimation of WRF) for 2000-2009, b) Monthly mean air temperature at 2 meters (°C, **top**) and monthly precipitation amount (mm, **bottom**) of observational data at the ECSF station (OBS, solid) and nearest corresponding WRF grid cell (WRF, dotted) for 2000-2009. Graphic: K. Trachte

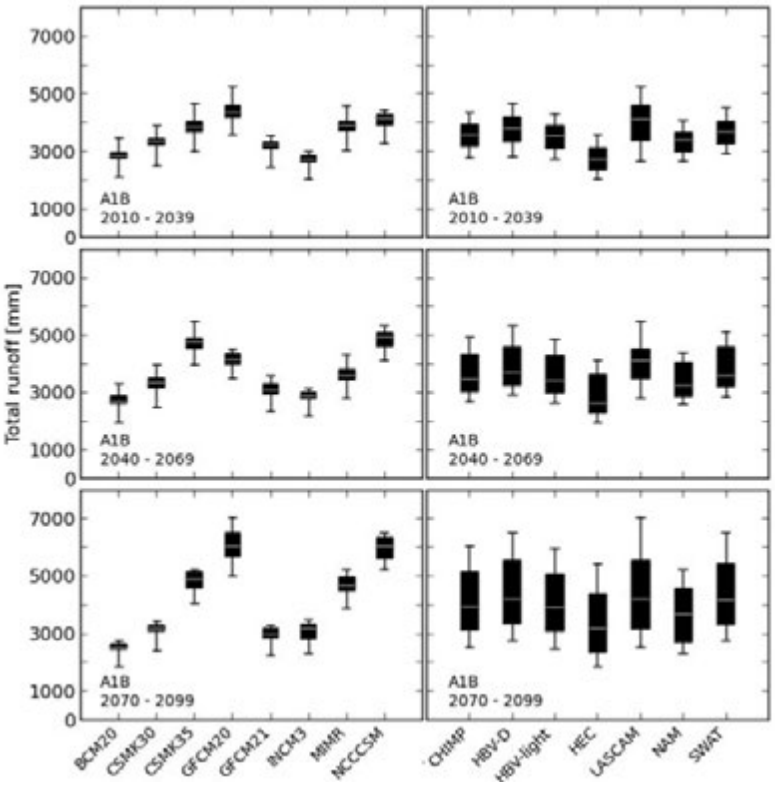

Figure 29 Uncertainty in the simulated total runoff as a function of Global Circulation Models (GCMs) used to drive the rainfall-runoff models (RRMs, **left**) and as a function of RRMs used with each of the GCMs (**right**) for scenario A1B and time period as indicated. Boxplots, 25 and 75 percentiles and max-min values. Graphics: J.-F. Exbrayat

Uncertainty in Projections of Future Runoff

It is well known that modelling climate change and its impact on hydrological conditions is often associated with uncertainty. This uncertainty can be traced to many different sources, such as the parameterization of the models, flaws or simplifications in the model structure. While parameter uncertainty has been well investigated in the past years, less is known about the effects of structural model uncertainty in hydrological modelling.

A multimodel ensemble was applied to challenge structural uncertainty of rainfall-runoff models (RRMs) in the Rio San Francisco area and expose model structures to represent relevant hydrological processes in project **D4**. Forcing data used to define the boundary conditions of RRM in use remain mostly unchallenged. While the input uncertainty for recorded time series might be relatively well known, future scenarios imply once more the structural uncertainty of (in this case climatic) models used to generate projections. In the case of climate change a series of Global Circulation Models (GCMs) exists, implementing emission scenarios from the Intergovernmental Panel on Climate Change (IPCC). By the means of ensemble modelling we accounted for the structural uncertainty introduced by the GCMs and combined it with the RRM ensemble.

Here we used an ensemble of 8 statistically downscaled GCMs for two emission scenarios (A1B, A2)[1] from the IPCC as input to compare the span of predictions with an ensemble of 7 RRMs (which has been recently published by Plesca [1]) from today up to the year 2100. As shown in **Figure 29** a large part of the uncertainty in future runoff projections can be attributed to discrepancies between GCMs indicated by the large variability between boxplots on the left and the broad range of predictions for each hydrological model to the right. Differences for the two IPCC emission scenarios remain relatively small (results not shown). Results of this new study are currently compiled for publication.

Lutz Breuer, Jean-Francois Exbrayat, Wouter Buytaert, Edison Timbe & David Windhorst

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1 The A1B scenario of the *Intergovernmental Panel on Climate Change* (IPCC) is the most likely emission scenario presuming a fast growing world population, globalization of ideas and economy, and a balanced use of fossil and non-fossil fuels. The A2 scenario assumes the development of a regionally oriented economy of self-reliant nations with a slowly increasing population.

The Data Warehouse System

The FOR816dw data warehouse (project Z1) is one of the major German project databases for interdisciplinary biodiversity research which encompasses not only the data base but also administration tools for the RU as well as a powerful Web interface for communication in- and outside the RU [1]. In full compliance with user needs [2], the state of technological development [3] and international standards [4] current developments of FOR816dw encompass (i) the implementation of data visualization and analysis tools and (ii) to distribute the system as an open source project.

(i) To enhance the direct access to the data values via the web interface, a module to draw a chart of a subset of tabular values has been implemented. After filtering the data of interest by setting criteria in the "Value Filter", the user can select the attributes for visualization, where the chart is drawn within the browser using the JavaScript library highcharts.com, which enables to interact with the chart like choosing the plot type, toggle the visibility of single data series, or zoom into the chart by selecting a span of interest. Additionally some statistics (mean, sum, and standard deviation) are calculated for the chosen span and data series (see **Figure 30**). The "Value Chart" module provides the researcher a quick view on the data and allows a first analysis. For more sophisticated analyses, the implementation of a R-software interface to the FOR816dw is planned.

(ii) After five years of development and running the system, it has reached a degree of maturity to share it with the community. The system will be offered as an open source project in early 2013 including the entire and licence-free source code as well as a documentation. Interested future users to implement (and co-develop) the system are currently the Ecuadorian Ministry for Environment (MAE), the Department of Biology of the Technical University in Loja (UTPL) and a new interdisciplinary LOEWE (Hessian excellence program) initiative led by the University of Gießen.

Thomas Lotz & Jörg Bendix

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Figure 30: Screenshot of the "Value Chart" module, which allows a quick visualization and a first analysis of the values in the RU's data warehouse FOR816dw. Screenshot: T. Lotz

a)

b)

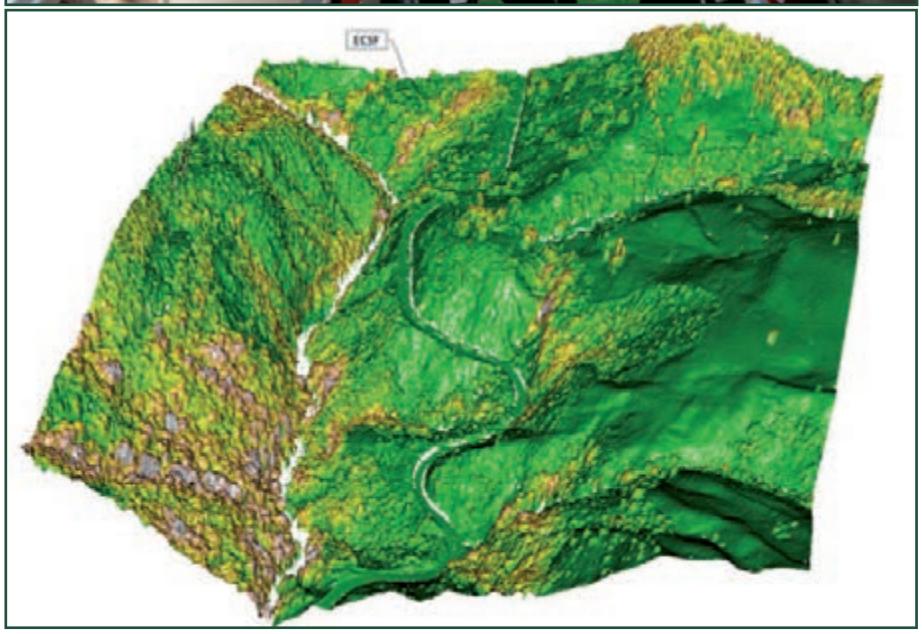

Figure 31 (a) View from helicopter over the tropical mountain forest. Steep terrain and weather are very demanding also for the flight planning. Photo: J. Zeilinger. **(b)** 3D digital surface model (DSM) with the canopy height as overlay and the ECSF research station in the background. Graph: B. Silva

Laser Scanning Mission in a Tropical Mountain Forest

Even if the project **Z2** is mainly responsible for administration and coordination of the RU, it has conducted the first Airborne Laser Scanning (ALS) mission in the catchment of the Rio San Francisco. Due to adverse weather conditions it was hitherto not possible to fly at higher altitudes, but the mission is scheduled to be completed in Oct-Nov 2012. For the lower parts encompassing the main experimental sites of the RU, important data could already be acquired: A high resolution Digital Surface Model (DSM) [1], a Digital Terrain Model (DTM) [2] and point clouds with comprehensive data about vegetation structure. The data are currently subject to an intensive quality check, a preliminary data version of the core area around the ECSF is available at the central data warehouse of the RU (FOR816dw).

Potential users have to take into account the processing status described within the metadata. A full homogeneous dataset will be available after the second flight and the final post processing. An individual FOR816dw module is planned to be developed to handle the distribution of the huge amount of point cloud data. **Figure 31a** shows the flight campaign which was a logistic and monetary challenge under the environmental conditions of a remote mountain forest site. The helicopter had to be transferred from Quito to the ECSF research station and a temporary heliport including a fueling truck had to be organized in the vicinity. The visualization of the preliminary data (**Figure 31b**) underpins the high value of the data for ecosystem studies which opens new dimensions for future research in the study area, ranging e.g. from single tree detection and spatial derivation of forest structure to carbon sequestration studies and statistical models relating forest structure, species diversity and ecosystem functions.

Jörg Zeilinger, Thomas Lotz, Brenner Silva & Jörg Bendix

References

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[2] The Digital Terrain Model (DTM) is available at: www.tropicalmountainforest.org/data_pre.do?citid=1126

Gender Equality Measure

Species Distribution and Genetic Diversity of Southern Bracken

The neotropical Southern Bracken (*Pteridium arachnoideum, Pt. caudatum*) consists of two species. According to Alonso-Amelot et al. [1, 2], *Pt. arachnoideum* is an upland species (1300 - 3200 m a.s.l.) while *Pt. caudatum* is mainly found in the lowlands (600 - 2100 m). Climate change, in particular warming may change the altitudinal species distribution. In the scope of the gender equality measure funded by the DFG (see the Speakers' Corner in this issue and Newsletter no. 12, doi: 10.5678/lcrs/for816.cit.999), bracken samples on active and abandoned pastures were analyzed for species composition within an altitudinal range from c. 1000 to 3000 m. The two species could be differentiated using morphological and molecular characters. We found an increase of the shares of *Pt. arachnoideum* with altitude and concomitant decrease of *Pt. caudatum* (**Figure 32**). Changing from the perhumid San Francisco valley to the drier Rio Malacatos valley, high proportions of *Pt. caudatum* were found at high altitudes. This finding contradicts the above mentioned altitudinal species distribution. The influence of temperature and humidity on the distribution areas of both bracken species is analysed in the diploma thesis of Ximena Cevallos from the Technical Private University of Loja (UTPL).

At 1900 m an extensive study of the genetic composition of the bracken population was performed using isozyme patterns as well as microsatellite markers [3]. As bracken propagates readily via rhizome branching and disintegration, a high degree of genetic homogeneity of the individual plants was expected. However, the percentage of ramets, i.e. genetically identical individuals, was low (2% for large scale sampling resolution, 31% for fine scale sampling within 1m^2) with spatial distances of less than 150 m which contrasts with findings of northern bracken species [4]. The high genetic diversity suggests a predominance of sexual over vegetative propagation which might be attributed to a high frequency of bushfires, the heat wave of which could stimulate sexual reproduction of surviving individuals.

Kristin Roos

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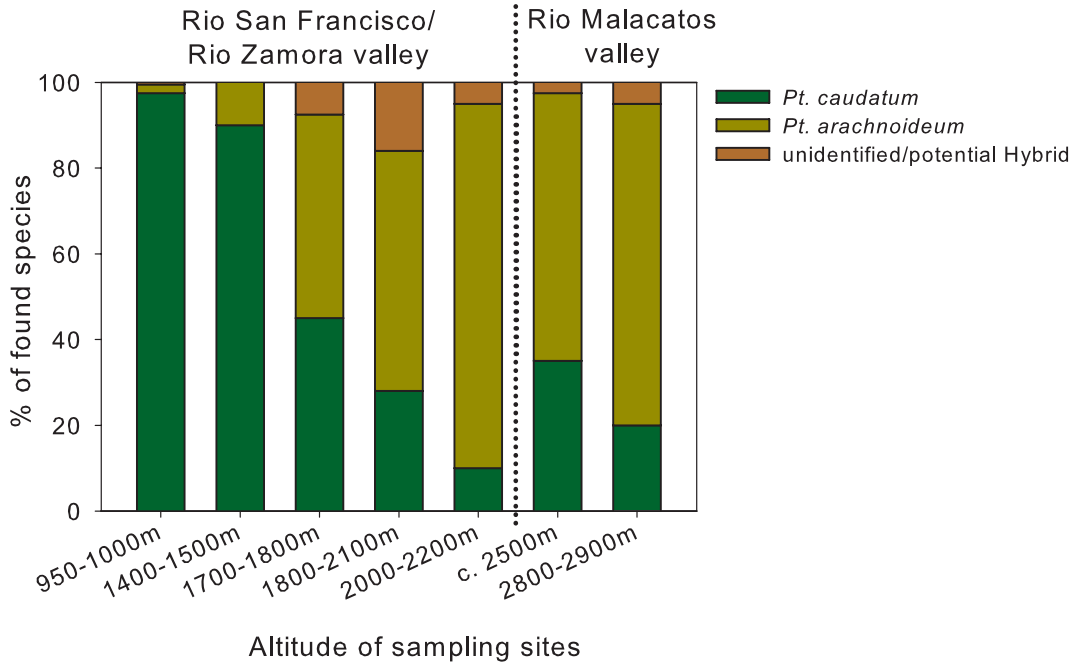

Figure 32: Species distribution of Southern Bracken along an altitudinal gradient in two valleys in South Ecuador. Image: K. Roos

Cooperations[1]

Podocarpus National Park Biodiversity

In the framework of the European Distributed Institute of Taxonomy (EDIT) All Taxa Biodiversity Inventory and Monitoring (ATBI+M) activities and in close collaboration with DFG RU816 we started a research program in Podocarpus National Park (ATBI site 680) in 2007. Our aims were to study the altitudinal distribution and the factors affecting the diversity of a selection of taxa: ants, termites, dolichopodid flies, and bark-dwelling arthropods. Over 5500 samples were collected and are still under investigation. Our main results (see also TMF-Newsletters, no 7, 12, 13, 14, 15 and 16) deal with:

- **Taxonomy:** 878 beetle, 250 ant, 200 dolichopodid, 41 opilion, 13 pseudoscorpion and 150 mite (morpho-)species were identified. Many taxa are new to science (**Figure 33**), among them 10 species of Staphylinidae, 1 species of Curculionidae and 1 genus of pseudoscorpion. Species of the genus *Stenus* (Staphylinidae: Steninae) had been barcoded, a laboratory standard for this taxon was developed (**Figure 34**).
- **Biogeography:** all taxonomic groups differ in general diversity, altitudinal diversity peaks and patterns, and species ranges. For instance, species richness peaked at high (3000 m; opilions), mid (2000 m; beetles, dolichopodids, pseudoscorpions) or low elevations (1000 m; ants). Most taxa presented a high species turnover along the altitudinal gradient. For tree-bark arthropods, the high biological diversity seems driven by the high heterogeneity of the environment (e.g. epiphyte coverage and bark roughness).
- **Ecology:** The diet and trophic position of ants relative to other organisms belonging to the leaf-litter food web was assessed thanks to stable isotope analyses (collaboration with S. Scheu & M. Maraun, project **A3**). Predatory ants seem to be more limited by habitat size (quantity of leaf-litter) rather than by prey availability. Beetle assemblages on barks proved a suitable tool for spatial (altitudinal) and temporal (time-scale) quick assessment, monitoring and calculation of diversity patterns and climate change responses. The installed botanical plots are an excellent platform to monitor this in the future.
- **Capacity building:** In 2011, a ten-day training on the taxonomy and ecology of ants was organized in cooperation with the UTPL and the ECSF. The course was attended by 18 Ecuadorian biologists.

Figure 33: This new ant species of the *Leptanilloides* genus was collected at 2100 m a.s.l. at the Reserva Biológica San Francisco (RBSF). Numerous other taxa collected in the nearby Podocarpus National Park are new to science. Image: Y. Laurent and I. Bachy (RBINS).

The scientific analysis of the 339 barkspray samples along the altitudinal gradient in Podocarpus NP resulted in six Master theses, several congress presentations, a publication (in prep.) and ongoing taxonomic work on beetles, harvestmen and pseudoscorpions. The study of the other groups resulted

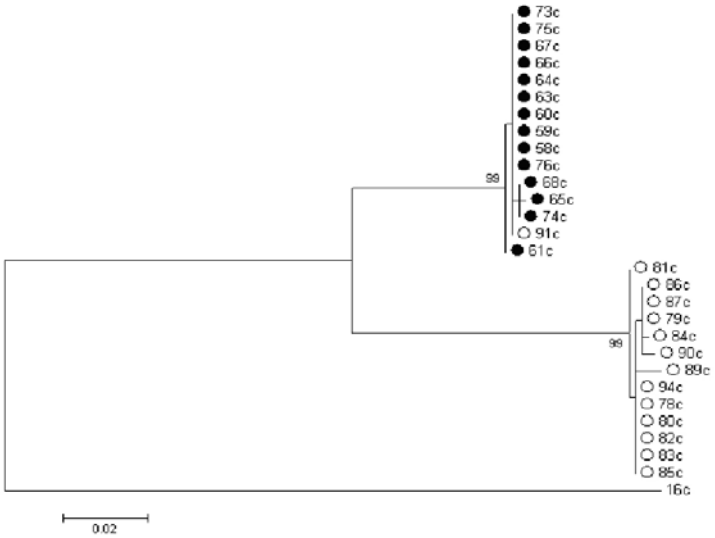

Figure 34: Molecular phylogenetic analysis of specimens of two *Stenus* morphospecies from 3000 m Cajanuma by Maximum likelihood method, 16c = *outgroup* (Pselaphinae); c = consensus-sequence; ◊ = morphological determination Spec. A; ● = morphological determination Spec. B. Barcoding also detected one specimen of morphospecies-missorting (91c, a female). Image: J. Schmidl

1 Scientists of the RU collaborate with several researchers and institutes outside the RU. This time the scientist from RBINS report their findings in this section. They are one of the institutions in the European Distributed Institute of Taxonomy (EDIT) and join forces to provide accountable tools to taxonomists, to significantly accelerate global taxonomic knowledge. The RU cooperates with researchers from EDIT since 2009.

in two Master and one PhD theses and six papers in peer reviewed journals.

Our studies confirm that the Ecuadorian Andes are a biodiversity hotspot for several invertebrates such as beetles, flies and ants. A major advantage of Podocarpus National Park for biodiversity studies is the exceptional availability of data on the physical environment, the know-how in special techniques (e.g. isotopes analyses) and the opportunity of collaborate in ongoing experiments such as the nutrient addition experiment (NUMEX).

Thibaut Delsinne[1], Jürgen Schmidl[2,3], Marc Pollet[3], Justine Jacquemin[1,4], Yves Roisin[4] & Maurice Leponce[1]

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Publications

Special Issue in *Ecological Modelling*

Modelling of abiotic and biotic processes in tropical rainforest dominated landscapes is still a challenge. While many of today's models have been developed and thoroughly tested for landscapes in Europe and North America, modeling approaches that explicitly aim at simulating soil, water or other fluxes in the tropics remain fairly scarce. In a recently published special issue of *Ecological Modelling* edited by Lutz Breuer from project D4, a set of models are presented that deal with diverse issues such as the (1) determination of driving forces of landslides, (2) simulation of canopy photosynthesis of competing species in Andean grasslands, (3) investigation of the impact of shallow landslides on forest structure and (4) functioning of catchments and rainfall-runoff generation processes in tropical mountainous rainforests of southern Ecuador. The special issue is available via doi:10.1016/j.ecolmodel.2012.05.027.

Lutz Breuer

Special Issue in *Ecological Informatics*

As reported earlier, an international workshop on „Data Repositories in Environmental Sciences" was organized by project Z1 in Rauischholzhausen (Germany), together with the DFG-biodiversity exploratories and the working group data of the DFG senate commission on biodiversity research. The papers on the focal issue of the symposium, Data platforms in integrative biodiversity research, could be recently published in a special issue of the journal „Ecological Informatics" which is available under: www.sciencedirect.com/science/journal/15749541/11 *Jörg Bendix*

Media Coverage

Contributing to Sustainable Development

On Sept 13 the German leading weekly newspaper the ZEIT[1] ("times") printed a piece which reports about the RU, the biggest research project to study a tropical mountain rainforest in the world. It describes the unique biodiversity around the ECSF research station and nearby Podocarpus National Park and introduces some of the questions the RU scientists like to answer. PhD student Julia Gawlik explains how the growing numbers of pastures threat biodiversity and sustainability. Some other threats to the ecosystem like climate change are mentioned as well. The scientists' efforts to find alternative land-use practices that are both good for the people and the ecosystem are outlined in the article entitled "Unter den Wolken" ("Beneath the Clouds"). To explain the vast biodiversity the author cites the 220 bird species registered so far; a number almost reaching the breeding bird species count of whole Germany which encompasses an area 32 thousand times that size. *esw*

Smart Initiatives to Stop Deforestation

The ARTE channel[2] showed a film about the threatened mountain rainforest around the Rio San Francisco and the research concepts of the RU scientists who strive to overcome non-sustainable land use practices. Sequences of the species rich rainforest and naked slopes devastated by fire were compared. The partnership cooperation between the German and Ecuadorian scientists was one focus of the 50-minute documentary film entitled „Ecuador – der große Deal" ("Ecuador – the Big Deal") which was shown in the German and French TV channel on September 3rd. It presented impressive

1 The ZEIT is printed weekly with a total of 500 000 copies and reaches an audience of approx. 2.6 million readers.
2 ARTE is a public service television channel of Germany and France. It addresses an audience interested in documentary films, historical and cultural topics as well as intelligent entertainment.

Figure 35: The cameraman and the sound engineer from the TV took a close-up in a small creek called Tres Cruzes. Photo: J. Gawlik.

images of the people, organisms and landscape (**Figure 35**) and can be supplemented by the 12 movies the scientists have produced about their work in Ecuador which can be seen at the Website of the German Research Foundation: http://dfg-science-tv.de/de/projekte/bedrohter-bergwald *esw*

Event Calendar

Status Symposium

The annual Status Symposium will be held in Spanish language and is scheduled for the morning of 19 October 2012 to be held at the Technical University in Loja (UTPL). It will encompass overview talks of 20 minute duration on the topics of the RU 816 which are also of interest for a broader audience, and a poster session (with posters in English and Spanish language).

gtö Conference

The next conference of the Society for Tropical Ecology (*gtö*) will be held in Vienna, Austria, on 2nd – 5th April 2013. RU member Professor Dr Konrad Fiedler will be the congress president.

Miscellaneous

"Pastoral Ecosystems" Researchers Invited to Sustainability Conference

Five members of the RU represented the research of the subprogram B "Pastoral Ecosystems" during the International Scientific "Conference on Sustainable Land Use and Rural Development" in Mountain Areas held at Hohenheim University, Stuttgart, 16-18 April 2012. Oral presentations were given in the sessions on agrobiodiversity and agrobiodiversity conservation by Julia Gawlik (University Erlangen, project B2) and Dr Kristin Roos (University of Bayreuth, project B1). They presented their results on phytodiversity and its impact on forage quality as well as on pasture rehabilitation strategies, respectively. The talks of Etienne Bahr (Dresden University of Technology), Leonardo Izquierdo (Universidad Técnica Particular de Loja) and Dr Ute Hamer (Dresden University of Technology) focused on the assessment of sustainable land-use management. Their reports paid particular attention to nutrient balances at farm level, economic and social indicators as well as soil quality indicators in the tropical mountain rainforest region of South Ecuador, respectively (all project B3). The presentations were given in the sessions on sustainability of land use change, water management and land use planning as well as on soil quality assessment. *Ute Hamer*

RU's Research Introduced in Colombia

Dr Ute Hamer (see also in "People and Staff", next page) received a grant from the German Academic Exchange Service (DAAD) for a short-term lectureship at the *Universidad Pontificia Bolivariana Bucaramanga* (UPB) in Colombia. Her teaching activities focused on soil quality and sustainable management strategies. During her one month stay at the UPB, a special conference was organized to present the research activities of the RU in Ecuador to all members of the Faculty of Environmental Engineering of the UPB. Students of the *Universidad de Cartagena* were connected via videoconference. On this conference Hamer explained the structure and the aim of the RU. Furthermore, she provided an overview on the assessment of soil quality in the region around the ECSF research station.

Ute Hamer

People and Staff


Photo: Hamer

Leader of project **B3** (Organic matter and microbial dynamics in pasture soils along management chronosequences), **Dr Ute Hamer,** successfully finished her habilitation at the Faculty of Forest, Geo and Hydro Science, Dresden University of Technology on 15th June 2012. Her cumulative habilitation thesis "Land-use change: Consequences for soil microorganisms and soil functions" presents an approach to assess the effects of changes in land-use or soil management on the soil microbial community with respect to biomass, activity and structure. Data obtained during her work in Ecuador (RU 816) were compared with data obtained in other ecoregions worldwide (China and Germany). Until know Hamer published 17 papers in peer-reviewed international journals (http://boku.forst.tu-dresden.de/index.php?hamer_peer_reviewed_journals_deu). The average citation per item is 33 with an H-Index of 8 (source ISI Web of Knowledge). After the work of Sven Günter and Rütger Rollenbeck, this is the third completed habilitation in the RU until now after Dr Sven Günter and Dr Rütger Rollenbeck.


Photo: Correa

Alicia Correa is a researcher of the *Grupo de Ciencias de la Tierra y del Ambiente*, Universidad de Cuenca with a main expertise in water resources, both from an experimental and modelling point of view. She started to work as PhD student in the group of project **D4** (Breuer) in summer 2012 and will focus on modelling water fluxes of Páramo ecosystems at different spatial scales. In particular, she will investigate the effect of upscaling on model parameters and their uncertainty. Her modelling work is accompanied by field experimental work utilizing stable water isotopes and trace elements to reveal the impact of different water flow paths on runoff generation. Her Ph.D. is funded by SENESCYT (Secretaria Nacional de Educación Superior, Ciencia, Tecnología e Innovación) and further supported through a DFG bilateral cooperation fund (see also Speakers' Corner).

Deadline

The editorial deadline for the forthcoming issue of the TMF Newsletter is:

November 15th 2012.

Please send your ideas, manuscripts and images to Esther Schwarz-Weig at the editorial office.
E-mail: esw@sci-stories.com

Credits and Contact

DFG Research Unit 816

More information about the Research Unit (RU 816) investigating Tropical Mountain Forests (TMF) is available at:
www.tropicalmountainforest.org

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