# RAINFOR-AMAZONICA Newsletter

December 2012 | No 8

## In this issue:

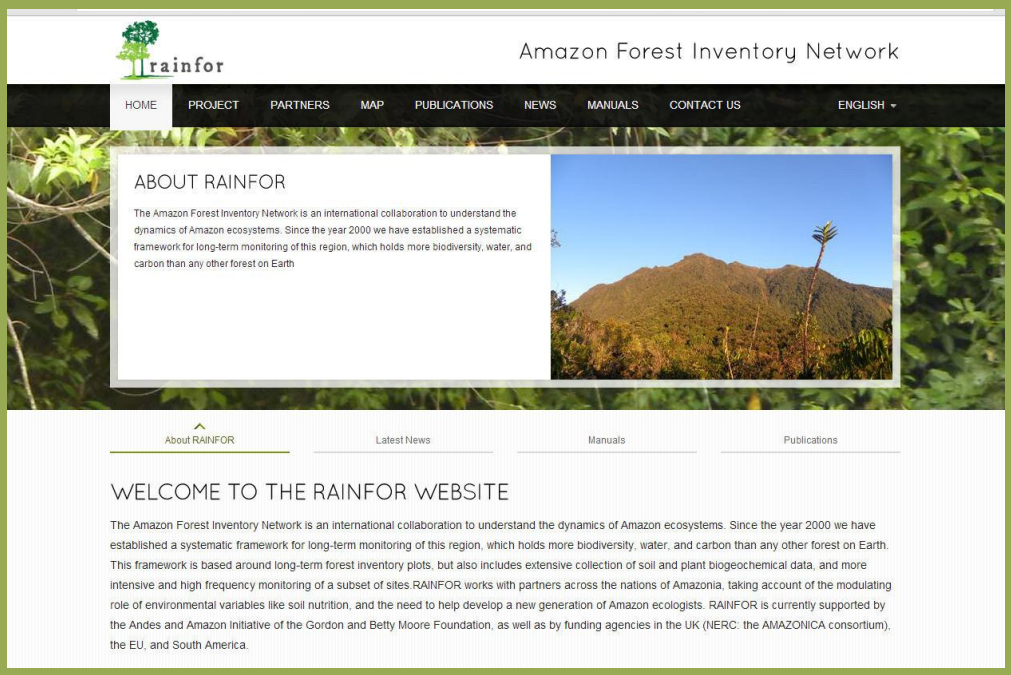


## TAKING THE PULSE OF THE WORLD'S BIGGEST TROPICAL FOREST:

**In the last year and a half, RAINFOR has visited more than 170 plots, recording the dynamics of species and carbon in locations across the Amazon. At dozens more sites, project teams have intensively sampled the soils and measured the intricate details of the forest carbon cycle. In the same short time period, the project has generated no fewer than 50 peer-reviewed science publications.**

**A huge thank you to all our friends and colleagues, and to the Moore Foundation for making this tremendous effort possible**.

- **Launch of new RAINFOR website**-We are pleased to release RAINFOR's new website design. We invite you to visit the new version of http://www.rainfor.org for regular news updates. We are now working hard to complete the whole site in all three languages. Let us know what you think, all suggestions welcome.




Read up on the Field Campaigns the RAINFOR people have been involved in across Amazonia: http://www.rainfor.org

**Recent fieldtrips include Peru and Venezuela**

**Venezuela 2012**
Fieldwork in Caatinga Forest

**Peru 2012**
Field team, Manu

Manu, Madre de Dios 2012

Equipo de campo, Manu, Madre de Dios 2012

Field team, Puerto Ayacucho 2012

*Gustavia acuminata*, an endemic species, Upper Rio Negro, Amazonas 2012

Equipment preparation for new GEM sites at Ducke Forest Reserve, Manaus, Brazil (photo: Jhon del Aguila Pasquel 2012)

- **Field Campaigns 2012**

  - **August-September 2012 – Manu, Madre de Dios, Peru**

    Over 8 weeks, Abel Monteagudo (Jardín Botánico de Missouri, Perú - RAINFOR), led a team of 7 Peruvian's: Víctor Chama Moscoso, Nadir Pallqui Camacho, Yuri Huillca Aedo, Dayana Suni Mendoza, José Luis Mateo Miguel and Adolfo Kapeshi. The team re-measured 10 permanent 1-2.25ha plots, located in forests surrounding el Estación Biológica de Cocha Cashu and then at Vigilancia de Pakitza (central Parque Nacional del Manu). Field work involved taking many boat trips along Rio Manu and setting up camp for several weeks at a time in order to access the more remote plots Altos de Cornfield, Cocha Otorongo and Cocha Salvador. In addition to the re-measurement of permanent plots and strengthening of established training methodologies, botanical specimens were collected of recruits and other trees requiring revision of their identification. These collections are currently being dried prior to identification at the herbarium at Oxapampa (HOXA). Data is soon to be made publicly available in the database ForestPlots.net.

    Abel Monteagudo

    Photographs: Abel Monteagudo, Yuri Huillca, Jose Luis Mateo

**Venezuela 2012:** our colleague Gerardo Aymard (UNELLEZ-Guanare) reports back on two field campaigns from earlier this year. Please visit the website for the full reports.

  - **November 2011 and February 2012- Puerto Ayacucho, Amazonas**

    With support from RAINFOR, 4 permanant plots of 1 Ha were established in forest close to Puerto Ayacucho, Amazonas, Venezuela. The team was lead by Gerardo Aymard (UNELLEZ-Guanare), and included José Farreras (UNELLEZ-Guanare), Franklin Molina (Ministery of the Environment), Michael Schwarz (RAINFOR), and a group of young indigenous men from the Piaroa ethnic group. These forests are found at the transition between the Llanos and the Amazon forest, in a región characterised by long periods of seasonal drought and heat. In spite of these climatic conditions, the forest communities here include numerous evergreen species. South of Puerto Ayacuhco (Sector Venecia) the forest is found on plains, with ultisol soils of moderately-good drainage, and in some locations have undergone selective extraction of two Erisma species for their wood. There are emergent trees (30-35m) of *Buchenavia parvifolia* ("Cumello"), *Eschweilera pedicellata*, *Hymenolobium petreum* ("Berraco") and *Erisma uncinatum* ("Salado"). North of Puerto Ayacucho the forests grow on oxisols, with poor to adequate drainage. This community is characterized by the presence of emergent trees of *Parkia pendula, Brosimum utile* and *Sloanea brevipes*.

  - **February 2012- Upper Rio Negro, Amazonas**

    After completing the work in the 4 Puerto Ayacucho plots, Gerardo Aymard and Franklin Molina travelled to San Carlos de Río Negro in a small plane, over the isolated forests of the Venezuelan Amazon. Here they met with Pedro Maquirino and his team to remeasure 2 permanent plots in the IVIC research zone. These plots, established 40 years ago, are among the oldest in the RAINFOR network, and interesting for their floristic composition and slow growth. The region of the upper Rio Negro contains a great complexity of vegetation types, among which the Amazon caatinga stands out, representing stunted forests situated on sandy spodosols of very poor drainage above rocks, with *Micrandra sprucei*, *Eperua leucantha*, *Compsoneura sprucei* and *Micropholis maguirei* all co-dominant. Other unique forests in this area are dominated by *Eperua purpurea* ("Yevaro"), found on raised areas with ultisols and spodosols. These communities have emergent trees, a high density of stems, and are typically well-stratified.

- **September-October 2012: Manaus, Brazil** GEM

  2 plots were set up within baixio and plateau forest in the Reserva Florestal Adolpho Ducke (RFAD), Brazil. These plots represent the beginning of 10 permanent sample plots which will be monitored by INPA researchers/students. Fieldwork is lead by Flavia Costa and Beto Quesada (INPA). Data collection was carried out by INPA students Erick Oblitas, Karina Melgaço and Hellen Santana, with training provided by John del Aguila Pasquel (IIAP Researcher). We have installed experiments for below-ground, above-ground NPP monitoring and CO2 efflux measurements. The research goals are to understand the effects of soil, topography, weather and watershed position on the carbon cycle in these forests.

  Jhon del Aguila Pasquel

# RAINFOR People

## Walter Huaraca Huasco

**Universidad Nacional se San Antonio Abad del Cusco, Peru**


Walter is currently co-ordinating fieldwork campaigns on the Andes to Amazon transect for GEM-RAINFOR collaboration.

**What are your main research interests?**

I enjoy and have experience in working and determining species in cloud forests.

**What projects have you been involved in?**

I first started to install permanent plots with Dr Miles Silman and Norma Salinas in Parque Nacional Manu, south Peru. These now form the Andes to Amazon transect. I have been working from 2006 to present for Dr Yadvinder Malhi on two projects and in 2008 I met Professor Oliver Phillips during a course with RAINFOR. Last year Dr. Yadvinder sent me to Malaysia to install seven permanent plots for Borneo's SAFE project. These were similar to RAINFOR's intensive carbon cycle monitoring plots. Following on from that I worked with Dr Toby Marthews to update the RAINFOR-GEM Field Manual.

**What are your plans for the future?**

Last January I presented my thesis and I'm now a Biologist. My next priority is to find a scholarship to continue my PhD in any part of the world, and then to continue working in climate change and conservation.

- **July 2012**

- **Pan-tropical study draws on RAINFOR plots, contribution by Dr Lindsay Banin (University of Ulster):**

**Scaling new heights: the architecture of tropical forests**

The maximum height and allometry of forests varies across the moist, lowland tropics. Using height and diameter data of 20,497 trees from forest plots in South America, Africa, Asia and Australia, the study, led by Lindsay Banin, shows that forests tended to be tallest in Asia followed by Africa, South America and Australia, and differed similarly for height at a given diameter. Environmental conditions, forest structure and wood density explain some of this variation, but differences across the tropical regions remained even when these were accounted for.

The research also examined whether the trees belonging to the dominant family in Asia, the Dipterocarpaceae, were driving the great height of these forests. Surprisingly, the dipterocarps did not differ significantly from the remaining families in terms of vertical structure; instead they may be conditioning the structure of the forest and precluding species which do not grow similarly tall.

These spatial patterns in vertical structure impose important implications for estimating biomass stocks and fluxes. The findings also raise new questions about other ways trees may be compensating for these architectural differences.

For more information: Banin et al (2012): What controls tropical forest architecture? Testing environmental, structural and floristic drivers *Global Ecology and Biogeography* 1466-8238 DOI: 10.1111/j.1466-8238.2012.00778.x

- **September 2012**

- **New ForestPlots.net publication available**

ForestPlots.net is a web application developed to provide a secure online environment for long-term forest plot data for researchers worldwide working within international networks such as RAINFOR, AFRITRON, and TROBIT, allowing scientists to manage, analyse, and compare their data to other sites. The underlying database (GIVD ID 00-00-001) in ForestPlots.net is a relational database which utilizes more than 50 tables to store plot location, individual taxonomic information and repeated diameter measurements for trees. Currently the database holds information on more than 800 plots from 27 countries with approximately half a million tropical trees tagged, measured, and monitored through time. The web application allows users, depending on their permission level, to view, edit, upload and download data of the plots they have access to. A novel feature of the database is the query library which produces outputs for the selected plots on biomass, basal area, wood productivity, and stem dynamics.

For more information: Lopez-Gonzalez et al (2012): ForestPlots.net – managing permanent plot information across the tropic. *Biodiversity & Ecology* Special Volume 4: Vegetation databases for the 21st Century 95-103 DOI: 10.7809/b-e.00064 http://www.biodiversity-plants.de/biodivers_ecol/article_meta.php?DOI=10.7809/b-e.00064

If you haven't visited ForestPlots recently, we encourage you to do so. Once you have your login/password combination you can explore the website in more detail.

- **RAINFOR presented to International Conferences**
- Abel Monteagudo (Jardín Botánico de Missouri, Perú-RAINFOR) presented 'Red Amazonica de inventarios forestales y base de datos forestplots.net' at the XIV Congreso Nacional de Botanica, Peru.
- Dr Simon Lewis (University of Leeds and UCL) presented 'On the ground monitoring of tropical forests: RAINFOR, AfriTRON and ForestPlots.net' at the European Space Agency's GlobBiomass User Consultation Meeting, University of Jena, Germany.

# RAINFOR People

## Demétrius Martins

**Instituto Nacional de Pesquisas de Amazonia, Brasil**

Demetrius was a Moore Foundation Master Fellow and has just received his Masters on INPA's Postgraduate Programme, supervised by RAINFOR's Flavio Luizão, Beto Quesada and Ted Feldpausch.

**What are your main research interests?**

Understanding the mechanisms that affect ecological processes in local and global scales. Such aspects were addressed in my masters thesis where I tried to understand the main drivers of necromass stocks variation in different soil types across Central Amazonia.

I tested relationships between necromass, soil and forest structure. 79 plots of 0.5 ha were assessed along a transect spanning ~700 km over a one-year period (2010–2011) in undisturbed forests from north of the Rio Negro to south of the Rio Amazonas. The field work took place in the state of Amazonas in Brazil. A great amount of the plots were located across the Purus – Madeira interfluvial zone on a ~600 km transect established along the Manaus – Porto Velho road (BR-319).

I also estimated the density of dead wood debris and evaluated soil physical properties by digging 2m deep pits following the standard protocol of RAINFOR. Vegetation data were obtained from permanent plots. We concluded that soil physical properties are likely to influence forest structure and dynamics which in turn affect necromass production and stocks.

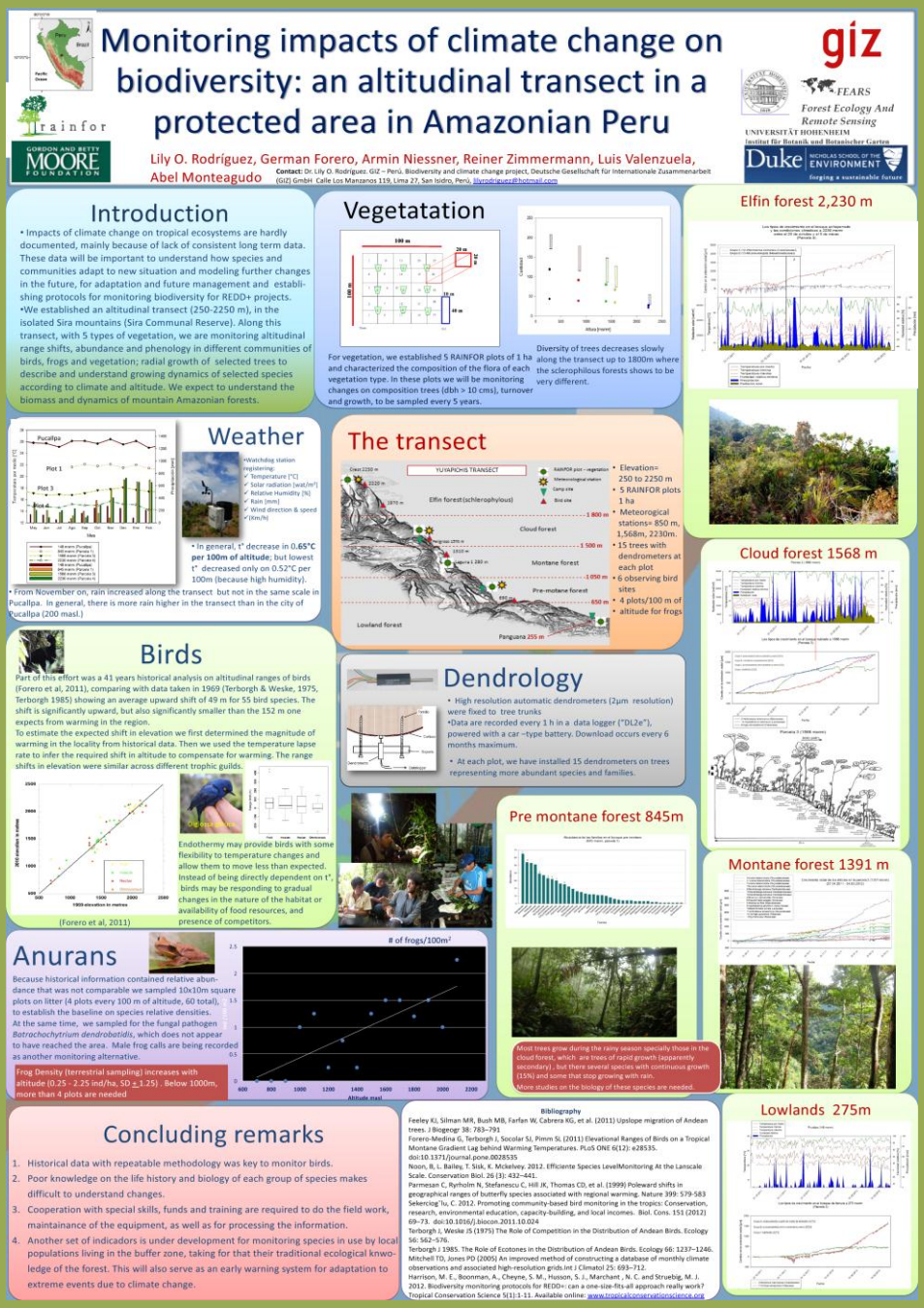
**What are your future plans?**

At the moment I am working to increase the soil sampling coverage to describe the pedological features of soil and also assessing the relationships between diameter and heights in the Purus- Madeira interfluvial area. After finishing the current project I hope to apply for a PhD in my research interest area. I found studying the Amazon to be spectacular and I expect to still be doing it in the next years in my PhD.

- **RAINFOR plots presented in China**

  Dr Lily Rodriguez (GIZ-Peru: Biodiversity and Climate Change Project) presented a poster: 'Monitoring impacts of climate change on Biodiversity: an altitudinal transect in a protected area of Amazonian Peru' at the 31st General Assembly of the International Union of Biological Sciences (IUBS) held in Suzhou, China.

  This included work on 5 plots established in 2010 with the collaboration of RAINFOR in Reserva Comunal El Sira, Peru. The plots cover an altitudinal gradient of 250-2250m and will be re-censused to monitor the composition of trees, turnover and growth.




For more information on plot establishment see our field campaign pages

# RAINFOR People

**Beatriz Schwantes Marimon**
**University of Mato Grosso (UNEMAT), Campus of Nova Xavantina, Brasil**

**When did you first work with RAINFOR?** March 2008, during field work in northeastern Mato Grosso.

**What are your main research interests?**

I am interested in working with structure and dynamics of different vegetation types of the southern Amazon boundaries in Central Brazil. I conducted my masters and doctoral research on the dynamics of mono-dominant and seasonal forests, and coordinated other ecological research in additional vegetation types in the transition zone between cerrado and Amazon Forest. My current work focuses on ecology and the management of forests in the transition zone between cerrado and Amazon forest biomes, and currently I have great interest in understanding changes in tropical plants communities as a result of climate change and human impacts.

**What projects are you currently involved in?**

I'm involved in "Assessing the impacts of the 2010 drought at the Amazon forest-savanna zone of tension", coordinated by Prof. Oliver Phillips; "Niche evolution of South American Trees and its consequences" coordinated by Prof. Toby Pennington and I co-ordinate the project "Transition Cerrado/Amazonia: ecological and socio-environmental basis for conservation". I'm currently visiting Leeds University revising and analyzing data from several projects already concluded and writing papers about the dynamics of the vegetation of the transition Cerrado/Amazonia, the distribution of species in flooding fields in Central Brazil and on structure and species composition of floodplain forests of the southern Amazon border.

- **Pan-tropical study featured in Nature**

Nature "Research Highlights" featured results from a new paper led by Dr Ted Feldpausch and colleagues from international projects RAINFOR, AfriTRON, TROBIT, and AMAZONICA, which was recently published in Biogeosciences. Research shows that incorporating tree-height data into calculations of aboveground carbon stored in tropical forests reduces estimates by ~13%.

'We collected data on forest structure from 327 tropics-wide plots, as well as estimating tree height for 42,656 trees across the tropics. Results show that information on tree height was crucial for accurately estimating biomass, and that calculated reduction of carbon storage in trees due to tree height varied by region. These results help to improve the accuracy of pan-tropical biomass estimates, are important for integration with remote-sensing, and are vital to policy instruments such as REDD+.'

For more information: Feldpausch et al (2012) Tree height integrated into pan-tropical forest biomass estimates. *Biogeosciences* 9 (8) 3381-3403

- **October 2012**

- **Tree rings reveal past Amazon rainfall**

BBC, BBC Mundo and Planet Earth online featured results from a new paper led by Dr Roel Brienen (University of Leeds). Roel and colleagues measured the ratios of two oxygen isotopes found in the tree rings of lowland tropical *Cedrela odorata* to quantify 100 years of rainfall patterns over the Amazon basin.

Isotopic signatures from just 8 cedar trees from a site in northern Bolivia gave insight into rainfall not just for that site, but for the whole Amazon catchment area. The isotope records were so sensative that it provides the most promising proxy for reconstruction of rainfall over the Amazon basin so far. For example the extreme 1925-1926 El Nino year clearly stands out in the record.

Photo: Roel Brienen (2012)

This method may provide a new path towards obtaining more insight into the hydrological cycle of the basin and indicate it is changing in a warmer world.

For more information:
- BBC News / BBC Mundo
- Planet Earth Online

Brienen et al (2012) Oxygen isotopes in tree rings are a good proxy for Amazon precipitation and El Niño-Southern Oscillation variability, Proceedings of the National Academy of Sciences, http://www.pnas.org/content/109/42/16957

- **Launch of new RAINFOR website**

We invite you to visit our new version of the website and welcome any thoughts or suggestions for improvement. Please continue to send us your updates, news and photographs. If you have not already done so, please check your contact details on the Partners page.

We would also like to update the map to include cluster specific images and links. Please send us the photograph you would like to be used for your plots or plot clusters, and your project websites. Please send any responses and photos to Georgia Pickavance (G.C.Pickavance@leeds.ac.uk)

Meeting of the Andes Transect group, at Sequioa National Park, California; Andes to Amazon Transect project (photo: GEM 2012)

Making equipment for new GEM sites at Ducke Forest Reserve, Amazona, Brazil; Lowland Amazon Forest project (photo: GEM 2012)

Andes (Photo: GEM 2012)

Manu, Madre de Dios, Peru (photo: Monteagudo /Huillca /Mateo 2012)

Field team, Manu, Madre de Dios, Peru (photo: Moteagudo /Huillca /Mateo 2012)

**Introducing 2 new RAINFOR associated projects aiming to extend the monitoring of forest processes across the tropics:**

**T-FORCES and GEM**

- **Contribution from Dr Cécile Girardin (GEM):**

**GEM: An innovative approach to science**

The Global Ecosystem Monitoring network (GEM) is an international effort to measure and understand forest ecosystem functions and traits, and how these will respond to climate change. Since 2009, the GEM team has been establishing a network of intensive carbon monitoring plots in South America, Africa and Asia. We measure the main components of net primary productivity and respiration to estimate gross primary productivity and carbon use efficiency. We aim to improve our mechanistic understanding of the carbon cycle and its interaction with environmental variables. The protocols used are based on those developed by the RAINFOR-GEM network and are explained in detail in the RAINFOR-GEM manual.

Capacity building is a key element of the work carried out by the GEM. In October 2012, we held an interactive training workshop in Libreville, Gabon, for the Agence Nationale Parks Naturels and ENEF teams. We covered the key theoretical concepts of the research, carried out many practical demonstrations of methods in the forest and introduced the first stages of data analysis with exercises.

The GEM website is an innovative approach to science. The GEM team is now spread over three continents. We are using the GEM application as a tool to coordinate our efforts through science networking. GEM field researchers regularly post questions and updates on the site. This site also allows us to stay in touch with the rest of the tropical ecology community: from the corridors of Oxford University to the remote terrains of the rainforest, get our latest scoops, communicate directly with the team, and delve into our photo diaries: http://gem.tropicalforests.ox.ac.uk/

- **Contribution from Professor Oliver Phillips (University of Leeds):**

**T-FORCES: Tropical Forests in the Changing Earth Systems**

The new five year ERC funded project **T-FORCES** aims to determine the changing role of tropical forests in the global carbon cycle. T-FORCES will address four questions:

• How are tropical forests responding to atmospheric change?
• What processes and drivers are involved?
• What are the risks to their long-term sustainability posed by climate change?
• How will these changes affect the overall carbon balance of the biosphere?

To tackle these questions we will build and interrogate a pan-tropical observatory of tropical forest function. T-FORCES will build on the success of current and new networked initiatives in tropical forest monitoring, working with our colleagues in RAINFOR, and also AfriTRON, TROBIT, ForestPlots.net and GEM. The scientific approach of T-FORCES will be to take advantage of geographical contrasts that offer opportunities for 'natural experiments'. We aim to determine forest dynamics and change along environmental gradients within continents to assess current transient responses, and where possible these will be complemented by elevational transects as space-for-time treatments to assess long-term temperature sensitivity. Continents (Africa, South America, Asia) will also provide replicates for global-scale tests of the generality of longer-term changes, as well as being independent 'climate laboratories' to investigate effects of natural climatic extreme events.

- **Contribution from Bill Laurance (James Cook University, Australia):**

**Will tropical protected areas sustain their biodiversity?**

In a recent paper in Nature, we found enormous variability in the biological health of tropical protected areas.

Around half of the reserves we surveyed are doing okay, but the rest are suffering. They have declines in top predators, their largest animal species, amphibians and reptiles, freshwater fish, epiphytes and old-growth trees, among others. The suffering reserves don't have enough on-the-ground protection, but the habitats around them are also under assault: 85% of the reserves we studied had lost surrounding forest cover in recent decades (see photo).

This is bad news for parks. Isolated habitats tend to lose species whose small, fragmented populations are cut off from life-giving immigration and gene flow. Moreover, threats outside protected areas tend to leak inside them. Protected areas are like mirrors—reflecting, to a degree, the health of their immediate surroundings.

It is the conspiracy of external and internal hazards that is most dangerous for biodiversity. The bottom line is that we can't simply set aside nature reserves and forget about their surroundings.

Reference**:** Laurance, W. F. et al. (2012). Averting biodiversity collapse in tropical forest protected areas. *Nature* 489:290-294.

Recent deforestation for oil palm plantations along the edge of Bukit Palong National Park in Peninsular Malaysia (photo: William Laurance)

## Latest RAINFOR publications:


Banin, L., Feldpausch, T. R., Phillips, O. L., Baker, T. R., Lloyd, J., Affum-Baffoe, K., Arets, E. J. M. M., Berry, N. J., Bradford, M., Brienen, R. J. W., Davies, S., Drescher, M., Higuchi, N., Hilbert, D. W., Hladik, A., Iida, Y., Salim, K. A., Kassim, A. R., King, D. A., Lopez-Gonzalez, G., Metcalfe, D., Nilus, R., Peh, K. S.-H., Reitsma, J. M., Sonké, B., Taedoumg, H., Tan, S., White, L., Wöll, H. and Lewis, S. L. (2012) **What controls tropical forest architecture? Testing environmental, structural and floristic drivers**. *Global Ecology and Biogeography.* doi: 10.1111/j.1466-8238.2012.00778.x

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Goodman, R.C., Phillips, O.L., Baker, T.R. (2012) **Tropical forests: Tightening up on tree carbon estimates.** *Nature* 491 (7425) 527-527 doi:10.1038/491527b

Lopez-Gonzalez, G. & Phillips, O.L. (2012) **Studying the Amazon: the experience of the Amazon Forest Inventory Network** *Ecosistemas* 21 (1):1697-2473. www.revistaecosistemas.net/articulo.asp?Id=708

Prickett RM, Honorio CEN, Baba Y, Baden HM, Alvez VCM & Quesada CA. (2012) **Floristic inventory of one hectare of palm-dominated creek forest in Jenaro Herrera, Peru**. *Edinburgh Journal of Botany* 69 (02): 259-280. doi:10.1017/S0960428612000030

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UNEMAT students Araguaia Floodplain, Central Brazil (photo: Bia Marimon 2012)

Soil sampling, Puerto Ayacucho, Venezuela (photo: Gerardo Aymard 2012)

Manu, Madre de Dios, Peru (photo: Moteagudo /Huillca /Mateo 2012)

Rosa Maldonado using a floating chamber to measure CO2 flux of a small stream. Attached to the bridge poles is a floating chamber used for accumulation of outgassed methane that was sampled from the headspace.

Leena Vihermaa attaching the stem flow collection system on a tree. Samples of stem flow were collected for DOC analysis immediately after rain events and the total volume determined.

Manu. Madre de Dios, Peru (photo: Monteagudo /Huillca / Mateo 2012)

Liana (photo: Bia Marimon)

# AMAZONICA NEWS:

- **Update from the University of Glasgow**

The final field campaign at the Tambopata National Reserve, Perú, was successfully completed by Leena Vihermaa (March-June2012). The sampling campaign completed the data collection for dissolved inorganic carbon (DIC) and dissolved organic carbon (DOC) as well as direct measurements of $CO_2$ fluxes that have been measured during all three field campaigns. Some new experiments were also set up during this trip. A stationary floating chamber was deployed in the small streams and swampy areas to measure the flux rate of methane. In order to understand source of organic carbon samples of stem flow, throughfall and overland flow were collected. In addition to that outgassed $CO_2$ samples were collected from the studied streams and rivers for $^{14}C$ dating to establish the age of the carbon.

The active field work has now been completed but automated data collection from one of streams continues using a pressure sensor (water level measurement) and a Troll 9500 (pH, conductivity, dissolved oxygen, water temperature, atm. pressure) until the end of this year. Fabian Limonchi (PUCP), is taking care of the data download and maintenance.

The majority of the samples collected during the final field trip have been analysed and the analysis of DIC samples will be completed soon. This autumn the focus will be on data analysis, interpretation and preparation of publications.

Results of DIC work were presented by Susan Waldron at EGU general assembly 2012, Vienna, Austria and at the ASLO summer meeting, Lake Biwa, Japan. Results based on the direct $CO_2$ flux measurements were presented by Leena Vihermaa at the ASLO summer meeting.

Leena Vihermaa (University of Glasgow)

## Latest AMAZONICA publications:


Belikov, D. A., Maksyutov, S., Krol, M., Fraser, A., Rigby, M., Bian, H., Agusti-Panareda, A., Bergmann, D., Bousquet, P., Cameron-Smith, P., Chipperfield, M. P., Fortems- Cheiney, A., Gloor, E., Haynes, K., Hess, P., Houweling, S., Kaw, S. R., Law, R. M., Loh, Z., Meng, L., Palmer, P. I., Patra, P. K., Prinn, R. G., Saito, R., and Wilson. C. (2012) **Off-line algorithm for calculation of vertical tracer transport in the troposphere due to deep convection** *Atmos. Chem. Phys. Discuss.*, 12: 20239-20289

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Houweling, S., Gloor, E. et al., (2012) **Iconic CO2 Time Series at Risk** *Science* 337: 1038-1040 DOI: 10.1126/science.337.6098.1038-b.


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