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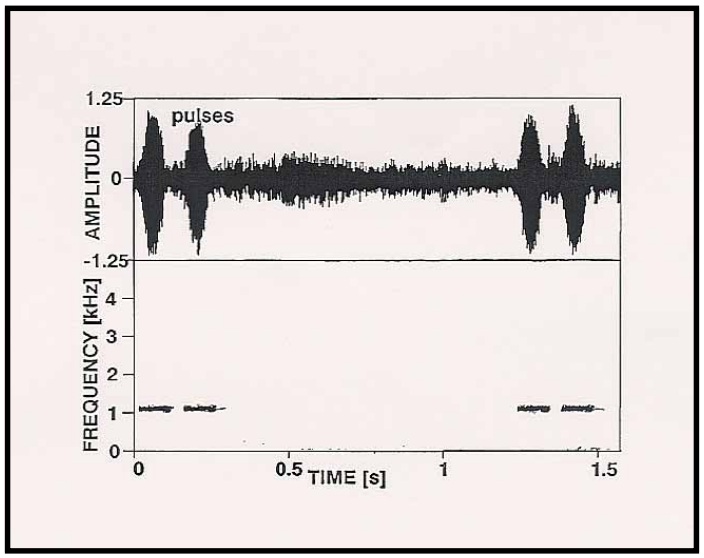
WHAT'S UP?

THE NEWSLETTER OF THE INTERNATIONAL CANOPY NETWORK

NALINI NADKARNI, EDITOR DAVID FRANKLIN, EDITORIAL ASSISTANT

Bioacoustic Measurement of Biodiversity (BaMBi)

A consortium of computer scientists, sound engineers, and biologists are developing an inexpensive, non-intrusive, and reliable new method for assessing biodiversity by analyzing the spectrum of insect sounds in forests. If successful, biodiversity assessment in forests will be as simple as walking in with a microphone and recording sounds. This is because the diversity of sounds made by forest insects is related to its species diversity, and because the stereotypic nature of insect sounds is specially suited for computer analysis, providing an excellent indicator group to work with.



The oscillogram shows the complex, but stereotyped, pattern of a grasshopper song

Currently, biodiversity assessments in the field are time-consuming and require extensive, and thus expensive, input from taxonomical specialists. Once the technology has been developed and the relationship between species and acoustic diversity established, this project will make it easier to detect and spatially map areas with a high number of endemic species. It will also contribute to current knowledge in informatics (particularly speech and pattern recognition). This will be invaluable for biodiversity monitoring and mapping. It will provide information for a hierarchy of decision-making in conservation, forest management, and environmental policy.

The project is coordinated by Andrew Mitchell, Global Canopy Programme, Oxford, UK, and Klaus Riede, Zoological Museum Alexander Koenig, Germany. Participating computer scientists are Professor Gunther Palm, University of Ulm, Germany and Mike Davies, Queen Mary University of London, UK.

First results and publications are summarized at ‹‹*http://www.dorsa.de*››.

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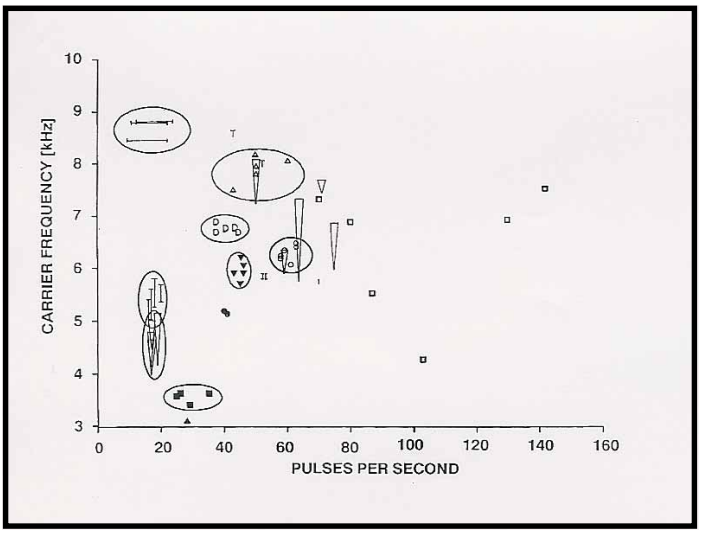

Parameter space of the bioacoustic cricket community from a tropical lowland forest in Ecuador, Amazonia (San Pablo de Kantesiya, Rio Aguarico). Species-specific ongs are characterised by carrier frequency and pulse rates ("beats"). Riede, K. 1993. Monitoring biodiversity: analysis of Amazonian rainforest sounds. Ambio **22**, 546-548.

The Towers Project

Introduction

Very little is known about rainforest canopy structure and function at the landscape scale, mainly due to logistical difficulties of working in tropical canopies. Stationary towers, canopy walkways, tree climbing, and cranes allow for vertical canopy access, but offer limited site choice and replication. With the newly launched "Towers Project" (*Proyecto Torres*), we have devised a novel way to gain access to complete vertical sections of the canopy and replicate them across the landscape of a wet tropical old-growth rainforest.

Early this June we began a two-year study, funded by the National Science Foundation, to sample over fifty tropical rain forest canopy cross-sections over the entire old growth forest landscape of the La Selva Biological Station in Costa Rica. La Selva, of the Organization for Tropical Studies, is located in the Caribbean lowlands in the Tropical Wet Forest life zone. At each vertical transect, a mobile aluminum tower is built to the top of the canopy, one 2-meter section at a time. The entire volume of biomass above each tower section is harvested and measured for structural variables. We measure gas exchange and other physiological measurements on the intact foliage off the side of the tower once it is completely constructed. After we have gathered all of our data, each tower is dismantled and reconstructed at the next randomly chosen site. Thus, we will be able to compare canopy structure and function across a vertical gradient (from the ground to the top of the canopy), and across a horizontal gradient (different soil types and terrain across the landscape), a feat never before attempted in a lowland wet tropical rainforest.

How the plots were selected

The two major variables used to select the plots were total soil phosphorous and slope class. Three classes of phosphorous concentration and three classes of slope yielded a grid of nine slope x phosphorous combined classes. Using GIS software and La Selva maps with quadrats of 10 by 10 m, we randomly chose 70 possible tower sites distributed across the 9 classes. We excluded swamps, plots where long-term research is taking place, and saturated soils near streams. These sites were then visited on the ground, and plots were eliminated due to rocks, large trees, and unstable areas for a total of 54 feasible tower sites.

Measurements of canopy structure

A Costa Rican construction crew of six are employed to construct the towers and move the sections. Paulo Olivas, the forestry and field technician, manages collection of canopy structural data. Prior to construction, soil samples are collected for nutrient analysis at four depths between 0-100 cm. Before any plants are collected, a fish-eye photo is taken at each new section, from which we calculate canopy openness along the vertical transects, and an estimate of leaf area index at each section before the section above is harvested.

Every living plant part above ground within an 8.3 m^3 is then harvested. When the first section of the tower footprint is clean, construction starts. The mobile aluminum tower is divided into sections of 1.3 x 1.86 x 1.86 m. An extendable platform allows us to collect an extra volume of approximately

3.8 m^3. We have enough sections to build a tower up to 46 m high.

The collected plants are divided into functional groups. With the help of on-site naturalists, we have also been able to identify almost all of the sampled plants to species. All the leaf material collected is taken to the laboratory and measured for total leaf area to calculate leaf area index (LAI). All of the stems, branches and other non-leaf material are also collected and weighed for total biomass. We will know the proportion of each group and their distribution throughout the canopy in terms of leaf area, abundance, strata, and biomass.

Once the tower is completely built, we measure another estimate of LAI off to the side of each tower section using an LAI 2000 (LI-COR, Lincoln, NE). We can then compare the LAI estimates resulting from the fish-eye photos and LAI 2000 with the LAI from the measurements of total leaf area from destructive sampling. Neither of these methods has been ground tested in this manner in a tropical rainforest. Photographs are also taken horizontally from the tower every 2 m to evaluate changes in leaf angle with changes in canopy height.

Measurements of canopy function

In addition to collecting structural canopy data with destructive sampling, we are also using the tower to gain access to intact foliage and branches for gas exchange measurements. Steve Oberbauer of Florida International University (FIU) in Miami; and Mike Ryan of USDA Forest Service Rocky Mountain Research Station in Ft. Collins involved in canopy physiological function. Molly Cavaleri, a Ph.D. student in ecophysiology at Colorado State University; and Harlyn Ordoñez, a full-time ecophysiology technician for the Towers Project, manage the physiology data collection and analysis. Andrea Garcia, a master's student in ecophysiology at FIU, will study leaf optical properties. Once the tower has been constructed, we measure photosynthesis just outside the tower footprint along the entire vertical profile with a LI-COR 6400. We collect data for photosynthetic capacity, light curves and intercellular CO_2 curves on each species. Branches and boles are also measured for woody respiration from the tower using an LCA-3 infra-red gas analyzer (Analytical Development Company, Hoddeson, UK). After the intact photosynthesis measurements are taken from the tower, samples of each species along the vertical profile are cut underwater, taken back to the laboratory, and measured at night for respiration. All leaf material measured for photosynthesis and respiration is collected and measured for specific leaf area (SLA, a measurement of leaf thickness). These samples are then archived for future nutrient analysis and isotope analysis.

Measuring abiotic factors

The tower infrastructure is also being used to investigate relationships between abiotic factors and physiological measurements along the vertical canopy transect. A series of six temperature and humidity sensors are hung along the entire length of each tower, each equipped with a radiation shield and a datalogger. We will also use the tower to measure the fraction of photosynthetically active radiation (FPAR) within the canopy.

Applications of data

Modeling Parameters

Mike Ryan is the principal investigator involved in compiling canopy ecophysiological models. Canopy structural measurements and abiotic parameters will be used in modeling total ecosystem gas exchange. FPAR, LAI, and biomass estimates will be used to scale up photosynthesis measurements and respiration measurements to the ecosystem. Leaf angle is another useful parameter in photosynthesis modeling.

Ground Testing Remote Sensed Data

We will also relate our ground data to remote-sensed data, such as satellite estimates of LAI and FPAR. Panoramic photographs are taken in the uppermost tower section to help locate the tower site with respect to satellite images, using emergent canopy trees.

Global Climate Change

La Selva's resident long-term researchers, Deborah and David Clark of University of Missouri, St. Louis, round out the Towers Project's four principal investigators. The Clarks,

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(from previous page)
along with Charles Keeling and Steven Piper of the Scripps Institution of Oceanography in La Jolla, California, recently reported in the *Proceedings of the National Academy of Sciences (PNAS)* that from 1984-2000 at La Selva, annual tree growth rates were negatively correlated with annual temperatures and with tropical terrestrial atmospheric CO_2 releases. This paper puts forth the controversial idea that in hotter years, tropical trees grow slower and become more of a CO_2 source rather than a sink. Very little is known, however, about the magnitude of carbon fluxes in tropical rainforests, or how sensitive they are to temperature. In the context of global climate change, altering the ratio of ecosystem photosynthesis to respiration would have significant consequences to global carbon flux. One of the major goals of this project is to better understand the relationships between photosynthesis and respiration in tropical rainforest ecosystems by scaling up chamber gas exchange measurements and projecting how these values may change with temperature.

Authors:
Molly Cavaleri, M.S. Colorado State University; ‹cavaleri@cnr.colostate.edu›.
Paulo Olivas, B.S. Towers Project Technician and Engineer
Harlyn Ordonez, M.S. Towers Project Ecophysiology Technician

Seasonality of nitrogen source availability of epiphytes in a tropical lowland rainforest

Introduction

Because epiphytes do not establish ground contact, they are highly dependent on atmospheric inputs and conditions, e.g. air humidity, temperature, rain, and solar radiation. Nutrients may either be derived from humus, accumulated on branches, or from atmospheric sources (Benzing 1989). Both undergo major fluctuations throughout the year (Bohlman et al. 1995). The aim of this research was to study the nitrogen (N) availability in a neotropical rainforest canopy, the seasonality of N input, output and pools, and the effect of N availability on epiphytic N uptake.

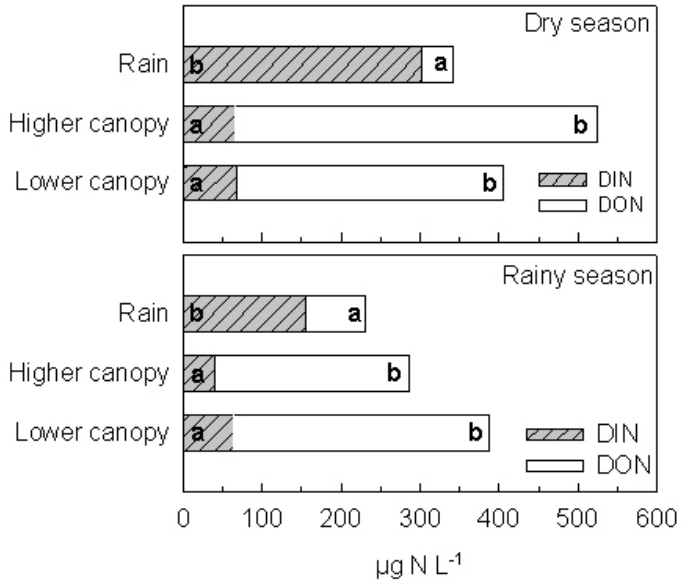

Fig. 1: Dissolved inorganic (DIN) and organic nitrogen (DON) concentrations in precipitation and in two throughfall categories (higher and lower canopy) during the dry and the rainy season. Different letters indicate significant differences of N concentrations between water qualities (Kruskal-Wallis Test, $P < 0.01$).

Methods

The fieldwork was carried out in the Esquinas forest, Piedras Blancas National Park, located on the south-pacific coast of Costa Rica, during the dry and rainy seasons, 2000. The Esquinas forest is classified as perhumid rainforest with an annual precipitation of about 6000 mm. Months with less than 100 mm can occur from January to March. Precipitation as well as throughfall within the canopy and below the canopy of three trees were collected, canopy organic matter was sampled from tree branches, ground soil and litter were sampled close to the investigated trees, and epiphytes were transferred to the field laboratory to conduct ^{15}N uptake experiments (potential ^{15}N uptake at 0.5 mM concentration). Ammonium, nitrate and a-amino-N were determined in precipitation, throughfall and water extracts of canopy organic matter and ground soil.

Results

Precipitation was enriched in dissolved inorganic N, but poor in dissolved organic N (Fig.1). While rainwater was passing through the canopy, ammonium and nitrate were depleted significantly, while organic N compounds were added to throughfall.

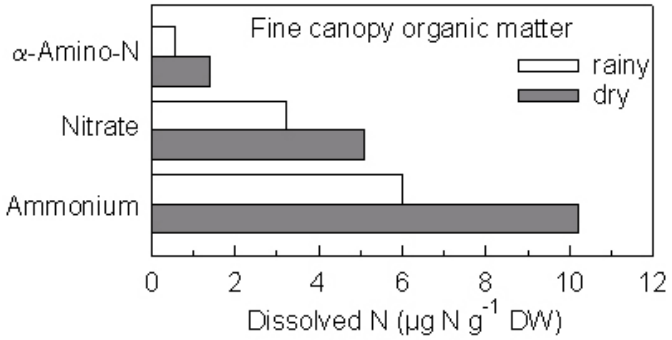

Fig. 2: Concentrations of ammonium, nitrate and a-amino-N in water extracts of canopy organic matter (<2 mm) in the dry and rainy season. No significant differences were found.

Other cations and anions analysed did not show such a reduction. In general, all nutrient concentrations were lower in the rainy compared to the dry season, although only inorganic N concentrations in precipitation differed significantly between the seasons. Lower N concentrations during the rainy season were outbalanced by higher rainfall amounts, leading to increased net fluxes of N. Net canopy exchange was close to zero during months with <100 mm precipitation. The yearly net canopy fluxes were estimated to be -8.4 kg N ha^{-1} yr^{-1} for inorganic N, indicating a net uptake by the canopy, and +10.7 kg N ha^{-1} yr^{-1} for organic N, pointing to a net release by the canopy.

Ammonium, nitrate, and a-amino-N pools in water extracts of canopy organic material were higher in the dry season and comparable to those of ground soil (Fig. 2). Water content of the rooting substrates were significantly higher during the rainy months (2.3 to 4.1 g FW g^{-1} DW), compared

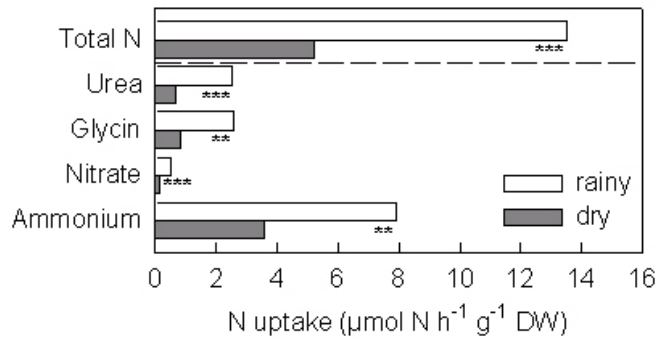

Fig. 3: N uptake by roots of different epiphyte species was significantly higher in the rainy compared to the dry season (Kruskal-Wallis Test, ** $P < 0.01$, *** $P < 0.001$).

to the dry months (1.5 to 1.8 g FW g^{-1} DW). ^{15}N Uptake experiments with different epiphyte species showed that ammonium was the preferred N form taken up by aerial plant parts and roots (Fig. 3). Potential uptake rates of all N forms were higher during the rainy than during the dry season.

Conclusions

Although there were only minor differences in the abundance of epiphyte N resources between seasons, nutrient scavenging by the canopy was greatly reduced during the dry season. The lower availability of water during the dry season seems to have a negative effect on epiphytic N uptake. Despite higher N concentrations in precipitation, net fluxes were estimated to be negligible during the dry season due to lack of water. This implies a strong dependency of canopy N fluxes and epiphytic N nutrition on water supply.

References

Benzing, D. H. 1989. The mineral nutrition of epiphytes. Pages 167-199 *in* U. Lüttge, editor. Vascular plants as epiphytes. Springer Verlag, Berlin.

Bohlman, S. A., T. J. Matelson, and N. M. Nadkarni. 1995. Moisture and temperature patterns of canopy humus and forest floor soil of a montane cloud forest, Costa Rica. Biotropica **27**:13-19.

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Contribute to What's Up?

The International Canopy Network (ICAN) is currently seeking articles and information for the upcoming issue of What's Up?, set for publication in December, 2003. ICAN accepts articles, meeting and workshop announcements, related website addresses, and citations. Contributions can be sent via e-mail attachment, fax, or snail mail. Articles up to 1500 words are accepted (WORD format preferred) and graphics are welcomed. The deadline for submissions is November 15, 2003. For further information or to send contributions, please contact the ICAN office:

David Franklin, Outreach Coordinator/Editorial Assistant; 2103 Harrison Avenue NW, PMB 612, Olympia, WA 98502; (360) 866-6788; ‹canopy@evergreen.edu›.

Have you recently moved or changed your e-mail address? If so, please let us know so we can keep your records current. E-mail your new information to ‹*canopy@evergreen.edu*›.

GCP Global Canopy Programme

GLOBAL CANOPY PROGRAMME UPDATE

Canopy Summit

On 11 July 2003, the Global Canopy Programme hosted a 'Canopy Summit' at the Royal Botanical Gardens, Kew, London, UK. The purpose of the meeting was to bring international funding agencies together with leaders in the field of canopy science to discuss the Global Canopy Programme's '20:20 Vision' for a network of forest canopy observatories, as outlined in the Spring 2003 edition of "What's Up?". The meeting was attended by representatives from Global Environment Facility, United Nations Environment Programme, Convention on Biological Diversity, UNESCO World Heritage Sites, Smithsonian Tropical Research Institute, INPA–Brazil, ATREE, India, various corporations, and members of the GCP Steering Committee.

There was a great deal of interest amongst attendees in the concept of a network of forest observatories as outlined in the 20:20 Vision summary, which was developed by the Global Canopy Programme Steering Committee, its secretariat and advisors, and ICAN.

This article briefly summarizes the conclusions of the meeting. A full report will be available from the GCP secretariat in the near future.

1. There was significant interest in the 20:20 Vision proposal from potential donors who attended the meeting. Any future GCP proposals for funding will need to be extended to meet the criteria and goals of UNEP, GEF, and UNESCO. A framework for doing this was created: The Global Canopy Programme was invited to work with UNEP to produce a Block 'A' proposal for submission to the GEF this autumn. If successful, this could lead to further proposals in early 2004 to develop the 20:20 Vision proposal into a suitable vehicle for GEF support at a larger scale. UNEP has agreed to assist the GCP Secretariat in developing these proposals.

2. Activities overlapping in the proposed network with UNESCO World Heritage sites might be used to support the currently evolving World Heritage Forest Programme. Possible links to sites in Madagascar, Malaysia, and Australia were identified. The proposed forest observatory network should integrate with and support other existing networks such as the Millennium Ecosystem Assessment, Below Ground Biodiversity in Soils (BGBS), Man and Biosphere Programme (MAB), and the Smithsonian Centre for Tropical Forest Science (CTFS) 50 hectare plots.

3. The existing temperate canopy crane network should be extended into the tropics as part of a coordinated and targeted research effort to understand emerging issues such as predicted climate change impacts on biodiversity at the canopy/atmosphere interface. Up to ten potential sites for new forest observatories with canopy cranes were identified; of these, 3–4 need to be prioritized in any proposal. Our paper in the journal *Science*, published on the day of the Summit, points to some key areas of research that could be considered. Future results must deliver outcomes of value to people and Governments.

4. Outcomes could be linked to the goals of the World Summit on Sustainable Development (WSSD), the 2010 goals Convention on Biological Diversity (CBD), and the 2012 renegotiation of the Kyoto protocol of the United Nations Framework Convention on Climate Change (UNFCCC). The activities of a forest observatory network and the Global Canopy Programme could possibly support the goal of greater collaboration between the CBD and UNFCCC through the established liaison group. Current differences of opinion among the Parties to these conventions on the role of forests in the mitigation of greenhouse gas emissions, requires some caution here.

5. The proposed forest observatories should connect related projects in a region, with canopy cranes acting as a flagship. These should also be part of an international network. Tropical observatories and cranes might be twinned with temperate ones.

6. The development of canopy based eco-tourism, as well as other means of providing benefits directly to local communities dependent on forests, should be further developed.

7. Letters of endorsement from relevant Government departments in several sponsoring nations must now be sought. Delegates from Brazil, Ghana, and India, present at the meeting, felt cautiously optimistic that such support could be obtained and agreed to help in this process. Malaysia could also be supportive, following GCP activities there. Any future proposal must consider what a National policy maker needs. Links to national biodiversity plans and other priorities must be established.

As an immediate response to the meeting, the GCP Secretariat is preparing a concept document in collaboration with UNEP in Nairobi. This we expect will lead to a submission of a Block 'A' proposal later this year to the GEF. We will also collaborate, as required, with relevant participants to pursue the directions suggested at the meeting, which have been outlined above.

We welcome interest from individuals or organizations who may wish to partner with this initiative in some way, or who would be willing to help introduce donors to help co-finance the programme.

The GCP thanks The Ernest Cook Trust and CHK Charities for funding what turned out to be a very successful Canopy Summit.

Australian Canopy Crane Update

Although the Australian Canopy Crane was rather quiet during the first half of the year, we are expecting to be quite booked for the reminder of the year. Two PhD students from the University of Leipzig are beginning three-year studies of phenology of black palms, and Mike Liddell and his team are preparing for a new exciting project, described below:

Net Ecosystem Exchange of Carbon, Heat and Water in a Tropical Rainforest. (CRC program 3 *Forest Canopy Dynamics and Processes*)

Project Leader: Dr Mike Liddell (JCU Chemistry).
Participants: Assoc. Prof. Steve Turton (CRC-TREM), Dr. Ron White (JCU Physics)
Student: Sabine Friedel (PhD, Mannheim, FRG)

-The aim of the project is to determine the steady state carbon, heat and water fluxes of a pristine rainforest using instrumentation, and to evaluate the diurnal and annual variations in response to changing climatic conditions.

-The JCU Flux site at Cape Tribulation has been running since 2001, collecting carbon flux data to assist in regional and global estimates of the carbon balance in tropical forests. The Cape Tribulation flux site has a strongly seasonal climate, with about 60% of the annual rainfall (3.5m) falling between December and March, and mean daily temperatures ranging from 28° C in January to 22° C in July. This climatic regime differs from most of the tropical carbon flux stations near the equator (non-seasonal). To this end, the JCU Flux site will make a notable contribution to the global picture of the carbon balance in old-growth tropical rainforests.

-The measurements being carried out at the JCU Flux site using the Australian Canopy Crane Facility include:
1) eddy covariance measurements of carbon dioxide, water and heat fluxes.
2) micrometeorological measurements.
3) soil carbon dioxide flux measurements (automatic closed chamber)
4) sap flow measurements (xylem transport)

-Plant physiologist Dr. Peter Franks (JCU), who is studying the leaf-level carbon / water balance of several species within the diverse forest is collaborating with the new project.

We have allocated two hours a day for the eco-tourism program in collaboration with the Cape Tribulation Resort. Hopefully, this commercial venture will help to subsidise the running costs of the facility and will lead to some reduction in hire costs to researchers.

Save a tree-receive "What's Up?" electronically!

In keeping with our mission of conservation, ICAN is pleased to announce the option of receiving "What's Up?" in .pdf format. Our intention is to reduce the amount of paper used for printing, as well as offering convenience for members who prefer electronic materials. The average size of the newsletter in .pdf format is 500 KB.

If you would prefer to receive the newsletter in .pdf format, please send an e-mail with your correct e-mail address to ‹*canopy@evergreen.edu*› and indicate your preference. Note that unless you request this option, you will continue to receive "What's Up?" in hard-copy format. You may change your preference at any time.

For more information or questions, please contact the ICAN office: (360)866-6788; ‹canopy@evergreen.edu›.

Announcements

EPA releases environmental indicator report without reference to climate change

The Environmental Protection Agency released a draft report on the state of the environment, but after editing by the White House, a long section describing risks from rising global temperatures has been whittled to a few noncommittal paragraphs. The report, commissioned in 2001 by the agency's administrator, Christie Whitman, was intended to provide the first comprehensive review of what is known about various environmental problems, where gaps in understanding exist, and how to fill them. Drafts of the climate section, with changes sought by the White House, were given to The New York Times by a former EPA official, along with earlier drafts and an internal memorandum in which some officials protested the changes.

EPA officials said they decided to delete the entire discussion to avoid criticism that they were selectively filtering science to suit policy. Administration officials defended the report, and said there was nothing untoward about the process that produced it. Mrs. Whitman said that she was "perfectly comfortable" with the edited version and that the differences over climate change should not hold up the broader assessment of the nation's air, land and water.

2003 International Conference on Tropical Forests and Climate Change: Carbon Sequestration and Clean Development Mechanism, from 21-22 October 2003 in Manila, Philippines. The objectives of the conference are to discuss the state of knowledge on carbon sequestration and the Clean Development Mechanism (CDM), to explore ways of enhancing the role of forestry projects in meeting sustainable development goals of developing countries and carbon reduction obligations of developed countries, and to strengthen linkage among researchers, policy makers, forest developer and NGOs working on carbon sequestration and CDM.

Contact: *APAFRI Secretariat c/o Forest Research Institute of Malaysia (FRIM) Kepong, 52109 Kuala Lumpur, Malaysia; Phone: 6 03 6277 3207; Fax: 6 03 6277 3249; ‹‹http://www.apafri.org››.*

Websites

SmartWood

SmartWood's purpose is to improve the effectiveness of sustainable forestry in conserving bio-diversity and providing equity for local communities, fair treatment to workers, and creating incentives for businesses so that they can benefit economically from responsible forestry practices. ‹‹*http://www.smartwood.org/*››.

A new atlas of biodiversity has been released by the UNEP World Conservation Monitoring Centre. For full text and graphics, visit: ‹‹*http://ensnews.com/ens/aug2002/2002-08-01.asp*››. Interactive maps from the atlas are available at: ‹‹*http:/stort.unep-wcmc.org/imaps/gb2002/book/viewer.htm*››.

Researchers find genetic response to global warming

University of Alberta biologist Stan Boutin and his research team have recently published findings that North American red squirrels exhibit genetic changes in response to a warming climate. The first site listed below contains a University of Alberta press release detailing this first-ever demonstration of genetic adaptation to global warming. The second site, from the Proceedings of the Royal Society, provides the abstract for this recently published research (full-text available only with paid subscription). With implications that extend far beyond the immediate research concerns of geneticists and environmental scientists, Boutin's work as presented in these sites should be interesting to a wide audience.

Changing Climate Prompts Genetic Change in Squirrels: ‹‹*http://www.ualberta.ca/~publicas/folio/40/12/front.html*››.

Genetic and Plastic Responses of a Northern Mammal to Climate Change:

‹‹*http://www.pubs.royalsoc.ac.uk/proc_bio/abstracts/reale.html*››.

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Global Climate Change Student Information Guide

The Global Climate Change Student Information Guide, available through Manchester Metropolitan University, presents "a comprehensive work for geology, geography, and environmental science students studying climate change." This online text offers detailed chapters covering the causes of climate change, the empirical study of climate, climate modeling, paleoclimatic change, and contemporary climate change. While topics covered lean toward earth sciences rather than life sciences, this site is a valuable resource for students of the highly interdisciplinary environmental sciences. ‹‹*http://www.ace.mmu.ac.uk/Resources/gcc/index.html*››.

WOODWEB's Forestry Forum

Do you have tree planting troubles, pest problems, or simply a strong desire to share your love of silviculture with others? Join in some tree-centric talk: ‹‹*http://www.woodweb.com/cgi-bin/forums/forestry.pl*››.

Friends of Trees

Based in Portland, Oregon, the Friends of Trees organization is dedicated to restoring urban forests around the country, with a particular emphasis on the Portland metropolitan area. As their Web site notes, "Tress are an essential part of the urban ecosystem. They help keep our water and air clean, prevent erosion, provide wildlife habitat, and make neighborhoods greener, more beautiful places to live." On the site, visitors can read about their ongoing planting activities and browse the newsletter they publish three times a year. For most visitors, the most helpful area of the site will be the Tree Resources section. Here, users can look through a fact sheet on the benefits of trees in urban environments, the care and maintenance of trees, and a large tree database. ‹‹*http://www.friendsoftrees.org/home/index.php*››.

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Birthplace of American Forestry

Focusing on the work on Carl Alwin Schenck, the noted German forestry expert, this online exhibit and archive created by the North Carolina State Library Special Collections Department (with the assistance of The Biltmore Company and the Forest History Society) offers a broad perspective on the Biltmore Estate Forest in North Carolina and the founding of the first school of forestry in the United States. Begun in 1898 by Dr. Schenck, the Biltmore Forest School operated on the grounds of the Biltmore estate in North Carolina, where Schenck had previously designed a forest management plan. During the school's 15 year existence, Schenck trained over 300 foresters, including Gifford Pinchot. The site features several historical essays on Schenck, the Biltmore Forest School, and the Biltmore Estate Forest. There are several photo archives of the Biltmore Forest School, a collection of oral histories dealing with early forestry education in North Carolina, and the forestry lectures of Dr. Schenck. ‹‹*http://www.lib.ncsu.edu/archives/forestry/index.html*››

From The Scout Report, Copyright Internet Scout Project 1994-2003. ‹‹http://scout.cs.wisc.edu/››.

Jobs

A postdoctoral position is available to study the ecology of zoonotic, vector-borne viral diseases in the Amazon basin of Peru as part of an ongoing project on the effect of deforestation on arboviruses. This is a unique opportunity to join a multidisciplinary team of mammal and insect ecologists, virologists and epidemiologists to study arbovirus ecology in the Iquitos region, an ecologically fascinating, tropical setting. Although a postdoctoral fellow is desired, applicants at other stages of career development will also be considered. Expertise in one or more of the following areas is desirable:

- Use of remote sensing and other spatial tools for landscape ecology and/or epidemiology
- Ecology and/or Systematics of neotropical rodents
- Ecology and/or Systematics of neotropical bats
- Field studies of zoonotic diseases

Contact: *Stephen P. Yanoviak, Ph.D.; Iquitos, Peru; ‹yanoviak@terra.com.pe›.*

Michael R. Willig, Ph.D.; Ecology Program, Department of Biological Sciences, Texas Tech University, Lubbock, Texas 79409-3131, USA; ‹michael.willig@ttu.edu›; Phone: (806) 742-2590

The Environmental Leadership Program (ELP) invites applications for the ELP Fellowship Class of 2004-2005.

The ELP Fellowship is an innovative national program designed to build the leadership capacity of the environmental field's most promising emerging practitioners. Each year, a new class of fellows is chosen to join a select group of environmental professionals from diverse backgrounds, sectors, and areas of expertise. The two-year fellowship offers unique networking opportunities, intensive leadership and skills training, time for personal and professional reflection, project seed money, support, and mentoring. Fellows receive travel and accommodations for four fellowship retreats; access to funding for leadership-building projects; and national recognition through the program. The ELP Fellowship provides an opportunity for talented individuals to have a unique and substantial impact on public affairs through collaboration with other emerging leaders.

ELP is a non-profit organization that seeks to transform public understanding of environmental issues by training and supporting a diverse network of visionary, action-oriented emerging leaders. Through its fellowship program, ELP provides training and project support to 20-25 talented individuals each year from nonprofits, business, government, and higher education. ELP is committed to fostering a reflective, diverse community of environmental leaders capable of responding to our complex social and environmental challenges.

Applications must be mailed to the ELP Fellowship Office, and postmarked by October 1, 2003. Application materials and further details are available at ‹‹*http://www.elpnet.org*›› or by contacting the ELP office: *Environmental Leadership Program Fellowship Office, P.O. Box 446, Haydenville, MA 01039; Phone: (413) 268-0035; Fax: (413) 268-0036; ‹info@elpnet.org›; ‹‹http://www.elpnet.org››.*

RECENT CITATIONS IN CANOPY SCIENCE

[Ed. note: Since there is no central journal on canopy science, it is useful to publish citations on canopy studies in the recent literature. Some of the papers listed below were obtained from ICAN subscribers sending in reprints; most were discovered through weekly literature searches on Current Contents on Diskette (CCOD).

CANOPY STRUCTURE

Lin, J. X., D. A. Sampson, G. Deckmyn, and R. Ceulemans. 2002. Significant overestimation of needle surface area estimates based on needle dimensions in Scots pine (*Pinus sylvestris*). Canadian Journal of Botany **80**:927-932.

Olthof, I., D. J. King, and R. A. Lautenschlager. 2001. Leaf area index change in ice-storm-damaged sugar maple stands. Forestry Chronicle **77**:627-635.

Raulier, F., P. Y. Bernier, C. H. Ung, and R. Boutin. 2002. Structural differences and functional similarities between two sugar maple (*Acer saccharum*) stands. Tree Physiology **22**:1147-1156.

ECOSYSTEM PROCESSES

Buchmann, N. 2002. Plant ecophysiology and forest response to global change. Tree Physiology **22**:1177-1184.

Nunn, A. J., I. M. Reiter, K. H. Haberle, H. Werner, C. Langebartels, H. Sandermann, C. Heerdt, P. Fabian, and R. Matyssek. 2002. "Free-air" ozone canopy fumigation in an old-growth mixed forest: concept and observations in beech. Phyton **42**:105-119.

Tarabula, T. 2002. Seasonal changes in foliage biomass and age composition of live and falling needles in Scots pine saplings treated with sulphuric acid, urea, or lime. Polish Journal of Ecology **50**:371-380.

FOREST MANAGEMENT

Rentch, J. S., F. Desta, and G. W. Miller. 2002. Climate, canopy disturbance, and radial growth averaging in a second-growth mixed-oak forest in West Virginia, USA. Canadian Journal of Forest Research **32**:915-927.

FOREST STRUCTURE

Bunyavejchewin, S., J. V. LaFrankie, P. J. Baker, M. Kanzaki, P. S. Ashton, and T. Yamakura. 2003. Spatial distribution patterns of the dominant canopy dipterocarp species in a seasonal dry evergreen forest in western Thailand. Forest Ecology and Management **175**:87-101.

Hinsley, S. A., R. A. Hill, D. L. A. Gaveau, and P. E. Bellamy. 2002. Quantifying woodland structure and habitat quality for birds using airborne laser scanning. Functional Ecology **16**:851-857.

Williams-Linera, G., A. Rowden, and A. C. Newton. 2003. Distribution and stand characteristics of relict populations of Mexican beech (*Fagus grandifolia* var. *mexicana*). Biological Conservation **109**:27-36.

FOREST-ATMOSPHERE INTERACTIONS

Asner, G. P., S. Archer, R. F. Hughes, R. J. Ansley, and C. A. Wessman. 2003. Net changes in regional woody vegetation cover and carbon storage in Texas Drylands, 1937-1999. Global Change Biology **9**:316-335.

Carignan, J., A. Simonetti, and C. Gariepy. 2002. Dispersal of atmospheric lead in northeastern North America as recorded by epiphytic lichens. Atmospheric Environment **36**:3759-3766.

deVries, W., G. J. Reinds, and E. Vel. 2003. Intensive monitoring of forest ecosystems in Europe 2: atmospheric deposition and its impacts on soil solution chemistry. Forest Ecology and Management **174**:97-115.

Falge, E., D. Baldocchi, J. Tenhunen, M. Aubinet, P. Bakwin, P. Berbigier, C. Bernhofer, G. Burba, R. Clement, K. J. Davis, J. A. Elbers, A. H. Goldstein, A. Grelle, A. Granier, J. Guomundsson, D. Hollinger, A. S. Kowalski, G. Katul, B. E. Law, Y. Malhi, T. Meyers, R. K. Monson, J. W. Munger, W. Oechel, K. T. Paw, K. Pilegaard, U. Rannik, C. Rebmann, A. Suyker, R. Valentini, K. Wilson, and S. Wofsy. 2002. Seasonality of ecosystem respiration and gross primary production as derived from FLUXNET measurements. Agricultural and Forest Meteorology **113**:53-74.

Farquhar, G. D., and M. L. Roderick. 2003. Atmospheric science: pinatubo, diffuse light, and the carbon cycle. Science **299**:1997-1998.

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Wong, C. S. C., X. D. Li, G. Zhang, S. H. Qi, and X. Z. Peng. 2003. Atmospheric deposition of heavy metals in the Pearl River Delta, China. Atmospheric Environment **37**:767-776.

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Brooks, J. R., F. C. Meinzer, R. Coulombe, and J. Gregg. 2002. Hydraulic redistribution of soil water during summer drought in two contrasting Pacific Northwest coniferous forests. Tree Physiology **22**:1107-1117.

Nunez, L., J. Plaza, R. Perez-Pastor, M. Pujadas, B. S. Gimeno, V. Bermejo, and S. Garcia-Alonso. 2002. High water vapour pressure deficit influence on *Quercus ilex* and *Pinus pinea* field monoterpene emission in the central Iberian Peninsula (Spain). Atmospheric Environment **36**:4441-4452.

INVERTEBRATES

Braun, D. M., B. Rancheng, D. C. Shaw, and M. VanScoy. 2002. Folivory of vine maple in an old-growth Douglas-fir-western hemlock forest. Northwest Science **76**:315-321.

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Zas, R., and R. Serrada. 2003. Foliar nutrient status and nutritional relationships of young *Pinus radiata* D. Don plantations in northwest Spain. Forest Ecology and Management **174**:167-176.

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Chiron, G. 2002. Epiphytic orchids from Sinnarnary basin (French Guiana). Acta Botanica Gallica **149**:289-297.

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Sprugel, D. G. 2002. When branch autonomy fails: Milton's Law of resource availability and allocation. Tree Physiology **22**:1119-1124.

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