

# WHAT'S UP?

## The Newsletter of the International Canopy Network

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Nalini M. Nadkarni, Editor

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### SUSCEPTIBILITY OF PODOCARP-BROAD-LEAVED FORESTS IN NEW ZEALAND TO GLOBAL CHANGE

A new, long-term research program to investigate the environmental regulation of carbon exchange and storage is now underway in a pristine, 600-year-old mixed podocarp-broad-leaved forest, dominated by rimu (*Dacrydium cupressinum*), at Okarito Forest, on the west coast of the South Island, New Zealand (lat. 170.3°E, long. 43.2°S). Collaborators at Landcare Research (David Whitehead, Fiona Carswell, and John Hunt) and the University of Canterbury (Matthew Turnbull and David Norton), in association with Timberlands West Coast Ltd. and visiting scientists from the Columbia University (Kevin Griffin, Kim Brown), The Black Rock Forest Consortium (Bill Schuster) and Texas Tech University, USA (David Tissue) are investigating the environmental regulation of carbon exchange between the vegetation and the atmosphere.

The native conifers of New Zealand, consisting of 8 genera and 17 species, have been isolated from northern hemisphere forests for 150 million years. The present-day forests are extensive, but largely confined to the lower slopes of the main axial mountain ranges running across both islands. Typically, annual rainfall is high (2-10 m). The trees grow on saturated soils that consist of highly-leached organic matter over glacial gravels. Canopy structure is complex, consisting of long-lived dominant podocarps (400 to 1000 years old) with younger podocarps

developing in an sub-canopy layer, broad-leaved trees as an understory, and a diverse layer of mosses and seedlings on the forest floor. In the absence of major sources of pollution in New Zealand, the tree stems and branches are covered with abundant epiphytes and lichens.

The unique species composition and distribution of these forests has been well studied from an ecological perspective, but an explanation of canopy structure based on physiological function has not been attempted. Many of the leaf-scale characteristics of photosynthesis and complex shoot structure that are now available for forests in the northern hemisphere have never been measured for most of the tree species.

As a signatory to the Framework Convention on Climate Change, New Zealand is required to report annually on the national inventory for storage of carbon in biomass. Despite the significance of the mixed podocarp forests to the national carbon budget, very little is known about the processes regulating carbon exchange and the capability of these forests as a carbon sink with changing climate.

If average annual air temperature continues to rise at its present rate, seasonal fluctuations in water availability become more pronounced, or the degree of cloudiness continues to increase, then a small shift in the carbon balance could result in the capability of these forests to act as carbon sinks to be reduced. This will have a major effect on the long-term sustainability of these forests.

We are investigating above- and below-ground soil and plant processes in the



Aerial view of the tower and the site at Okarito Forest, New Zealand. Photograph was taken by John Byers.

carbon balance in relation to nutrient status to determine limiting environmental and biological variables. Our scientific objective is to provide robust models to predict the effects of changing climate on the carbon balance and productivity in this ecosystem.

Access to the tree canopy has been achieved by the construction of a 22 m tall tower (designed and built by John Byers, Tony McSeveny, and Graeme Rogers, Landcare Research). A weather station is currently being installed at the site. The location of trees and canopies for all trees with a diameter greater than 50 mm were measured last summer, and photosynthetic and biochemical characteristics of the foliage of the main trees species were determined. Work to determine respiratory fluxes, eddy covariance measurements of net CO<sub>2</sub> exchange, and modelling ecosystem CO<sub>2</sub> exchange are planned for next summer.

This site also provides an excellent opportunity to investigate aspects of biodiversity in a multi-layered system, including the contribution of vascular and non-vascular plants in different components of the forest canopy to carbon balance, levels of host specificity among canopy invertebrate species, the reproductive biology of canopy trees, and the role of insects and birds with respect to pollination and seed dispersal.

We acknowledge funding for this work from the Foundation for Research, Science and Technology (New Zealand)

and the Andrew W. Mellon Foundation and Columbia University (USA) and Timberlands West Coast Ltd. for providing the site and assisting with construction of the tower.

For further details, contact David Whitehead at Landcare Research, Lincoln, New Zealand, ([whiteheadD@landcare.cri.nz](mailto:whiteheadD@landcare.cri.nz)), Kevin Griffin, Lamont Doherty Earth Observatory of Columbia University, New York, USA ([griff@ldeo.columbia.edu](mailto:griff@ldeo.columbia.edu)) or Matthew Turnbull at the University of Canterbury, Christchurch, New Zealand ([m.turnbull@botn.canterbury.ac.nz](mailto:m.turnbull@botn.canterbury.ac.nz))

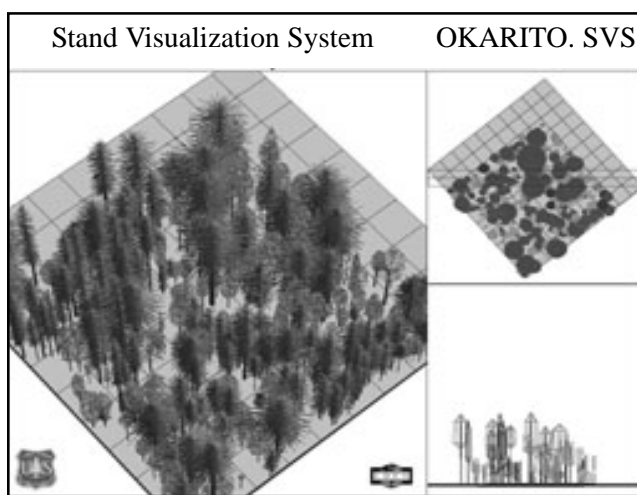
### STABLE ISOTOPES IN CANOPY RESEARCH

Isotopes are forms of an element with similar chemical properties but different atomic weights. In most chemical and physical processes, one isotope reacts slightly faster and others are discriminated against. Comparing isotope ratios in different compartments and following the discrimination in transformation processes allows us to study the sources and pathways of particular elements.

Discrimination against carbon-13 (d<sup>13</sup>C) has long been used to identify pathways of photosynthesis and to distinguish between C<sub>3</sub> and CAM epiphytes (Earnshaw *et al.* 1987). Within C<sub>3</sub> plants, d<sup>13</sup>C also serves as a measure of water stress and water-use efficiency, as half-open stomata result in a steeper CO<sub>2</sub> gradient and thus reduce discrimination against <sup>13</sup>C.

Because the nitrogen cycle is very complex, nitrogen isotope ratios offer many possibilities but may also be difficult to interpret (Högberg 1997). d<sup>15</sup>N/<sup>14</sup>N ratios of rain water are mostly lower than that of soils and plants. Bromeliads from six Mexican forests had lower d<sup>15</sup>N values than other epiphytes, indicating that they acquire nitrogen more directly from rain with their leaf trichomes than do other epiphytes, which absorb water and nutrients with their roots from canopy soils (Hietz *et al.* 1999, Stewart *et al.* 1995).

Among bromeliads, atmospheric forms had the lowest d<sup>15</sup>N values of any plant recorded because they absorb rainwater and throughfall directly via their dense trichome cover. Nitrogen from rainwater in the phytotelmata of tank bromeliads may be transformed prior to uptake and these plants also trap substantial amounts of tree litter, resulting in less negative d<sup>15</sup>N values than atmospheric species. Most, but not all, atmospheric bromeliads were also performing CAM photosynthesis, whereas tank species had d<sup>13</sup>C values typical for C<sub>3</sub> photosynthesis. Comparison with d<sup>15</sup>N signals of C<sub>3</sub> and CAM orchids showed that the <sup>15</sup>N discrimination was not related to the photosynthetic pathway but was related to the different nitrogen sources (Fig. 1). Along an altitudinal gradient the proportion of CAM epiphytes often decreases with increasing elevation and precipitation (Earnshaw *et al.* 1987, Hietz *et al.* 1999).



A 3-dimensional visual interpretation of the canopy using SVS software developed by Robert McGaughey and James McCarter (University of Washington, USA) from mensurational data for trees with diameters greater than 50 mm in a 50×50 m plot collected by Bill Schuster and Kim Brown. The visualization illustrates the distribution of foliage area in vertical “cylinders” with gaps in between, and the separation of the canopy layers.

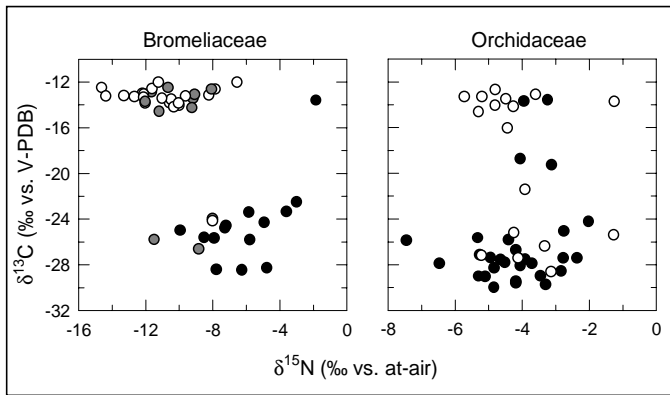
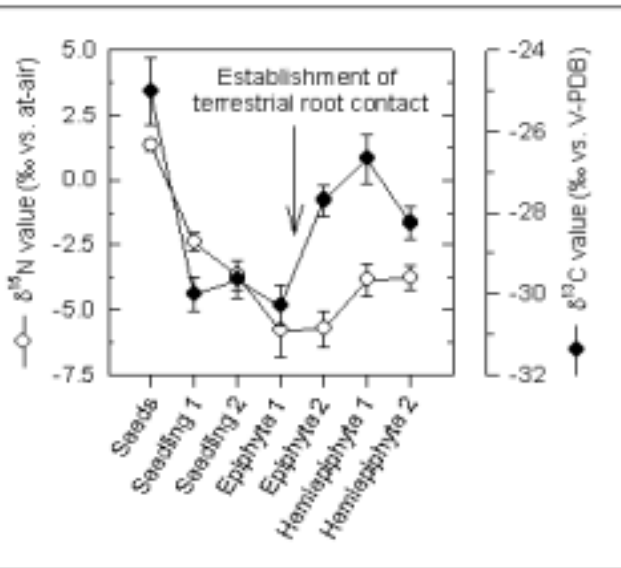


Figure 1. Carbon and nitrogen isotopic composition of different life forms of bromeliads [atmospheric (O), tank/atmospheric intermediate (◐), tank forms (I)] and orchids [leaf thickness < 2 mm (I), succulent leaves (O)] from six Mexican forests.  $\delta^{13}\text{C}$  values higher than c. -18 indicate CAM (from Hietz et al. 1999).

Our more recent research focuses on changes in  $^{15}\text{N}$  and  $^{13}\text{C}$  of several Mexican bromeliad species during growth and on the canopy nitrogen cycle in tropical rainforests. Many tank forms start with narrow-leaved atmospheric juveniles

from broad-leafed epiphytes, rain forest canopy nitro-



Collections from Costa Rica's Monteverde Cloud Forest and Esquinas lowland rainforest, which differ in their epiphyte biomass and composition, will yield the first research results in this direction. We are also studying physiological adaptations during the life cycle of the primary hemiepiphytic *Clusia* spp. of the Esquinas lowland rainforest. These show clear shifts in water and nutrient availability during the switch from the epiphytic stage to terrestrially rooted hemiepiphytes (Fig. 2).

**Literature cited**

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Contact: Peter Hietz, Inst. Botany, Univ. Agric. Sci., GMendel-Str. 33, 1180 Vienna, Austria, <hietz@edv1.boku.ac.at> and Wolfgang Wanek, Inst. Ecol. Conserv. Biol., Univ. Vienna, Althanstr. 14, 1091 Vienna, Althanstr. 14, 1091 Vienna, <wwanek@pflaphy.pph.univie.ac.at>.

Figure 2. Stable isotope composition of 3 *Clusia* spp. from the Esquinas rainforest, Costa Rica, during their establishment from seeds, seedlings and epiphytes to terrestrially rooted primary hemiepiphytes. Uptake of  $^{15}\text{N}$ -depleted nitrogen from canopy sources causes the  $^{15}\text{N}$  signature to decline until *Clusia* gains ground contact and access to soil nitrogen enriched in  $^{15}\text{N}$ . The valence for CAM metabolism (some *Clusia* spp. are to  $\text{C}_3$ -CAM intermediates) is – as judged by carbon isotope discrimination – quite low in seedlings and the early epiphytic phase and only increases in late epiphytic and hemiepiphytic stages (Wanek, unpublished).

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## **WIND RIVER CANOPY CRANE RESEARCH FACILITY ~ 6TH ANNUAL SCIENTIFIC CONFERENCE**

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The Wind River Canopy Crane Research Facility will hold its 6<sup>th</sup> annual Scientific Conference on June 16-18, 2000. As in previous years, this Conference will coincide with the annual meeting of the National Scientific Advisory Committee, a group of canopy researchers and ecologists who provide oversight and guidance on scientific policy to the Facility.

Below are the papers and presenters at the Conference. A special session on Soil Ecology will be held at the Conference, which will cover aspects of soils that have been studied and a discussion of other soil characteristics and processes that need to be investigated at the crane site.

All scientists and others who are interested in canopy research are welcome to participate in the Conference. Contact Dr. David Shaw, Wind River Canopy Crane Research Facility, Carson, Washington <[dshaw@u.washington.edu](mailto:dshaw@u.washington.edu)>.

### **INTRODUCTION**

Introductions/ State of the Research Facility: Jerry Franklin, Director, WRCCRF, and Univ. of Washington; The WESTGEC Research Program @ WRCCRF: Tom Suchanek, Director, Western Region of the National Institute for Global Climate Change, and Univ. of California, Davis.

### **CANOPY PROCESSES**

William Winner, Oregon State University, and Sean Thomas, Univ. of Toronto. Responses of leaf photosynthetic and optical characteristics of western tree species to rising CO<sub>2</sub> and temperature: scaling from saplings to mature trees.

Brian Lamb, Washington State University. The role of volatile organic emissions in terrestrial carbon exchange.

Barbara Bond, Oregon State University, and Mike Ryan, USDA Forest Service. Stand age, productivity, and hydraulic conductance of Douglas-fir in the Wind River Basin.

Tom Hinckley, University of Washington. Scaling up carbon dynamics from leaves to forests.

James Ehleringer and J. Fessenden, University of Utah. Stable isotope analyses at the Wind River Canopy Crane Facility.

### **EDDY FLUX AT WIND RIVER**

K.T. Paw U, University of California, Davis. Carbon dioxide exchange between and old-growth forest

and the atmosphere.

Jiquan Chen, Michigan Technological University. Net ecosystem exchanges of carbon, water, and energy in young Douglas-fir forests.

### **SCALING, MODELING APPLICATION**

Dar Roberts, Univ. of California, Santa Barbara, and Susan Ustin, Univ. of California, Davis. Scaling up the forests of the Pacific Northwest using remote sensing.

J. Kaduk, Chris Field; and Joe Berry, Carnegie Institute, Stanford Univ. Integrated ecosystem modeling at the Wind River Canopy Crane Site.

### **WESTGEC PROGRAM**

Walt Oechel, San Diego State Univ. A comparison of old-growth and chaparral carbon dynamics.

### **SPECIAL SESSION ON SOIL ECOLOGY**

Joel Norgren, Retired, Soil Conservation Service; Soil profile descriptions in the T.T. Munger.

Tom High, USDA Forest Service. Origin and distribution of the T.T. Munger Soils.

Mike Unsworth, Oregon State Univ., Danny Marks, USDI Geological Survey, Tim Link, Oregon State University. Measurement and modeling of water fluxes in a temperate seasonal rainforest.

Jeff Klopatek, Arizona State Univ. Soil and litter carbon processes in old-growth and young plantation Douglas-fir ecosystems.

Mark Harmon, Oregon State Univ. Preliminary studies on the carbon flux associated with woody detritus in forests surrounding the Wind River Crane Site.

Hal Mooney, Stanford Univ. Root distribution, phenology and carbon balance.

Discussion: Is the carbon all going below ground? Are these soils representative? What investigations would we propose if money was no object?

### **FOREST CHRONOSEQUENCES AND DATABASE MANAGEMENT AND DEVELOPMENT**

Nalini Nadkarni, The Evergreen State College. Overview of global forest canopy program and how Wind River can contribute to it.

Judy Cushing, The Evergreen State College. Development of a canopy database for harmonizing canopy structure/function studies.

Robert Van Pelt, The Evergreen State College. Preliminary studies on forest canopy structure/function relationships in a 1000 yr chronosequence of Douglas-fir forests, western Cascades.

Jerry Franklin and Mark Swanson, Univ. of Washington. Measuring and mapping large blocks of young and mature forests near the WRCCRF.

**FOREST STRUCTURE/DYNAMICS**

David Woodruff, WRCCRF. Phenological calendar for the WRCCRF Forest.

Jiquan Chen, Michigan Technological Univ. Spatial patterns of forest productivity.

Hiroaki Ishii and E. David Ford, Univ. of Washington. Dynamics of Douglas-fir foliage and branches.

**WILDLIFE ECOLOGY/DYNAMICS**

Cathey Flick, USDA Forest Service and David Shaw, WRCCRF. Vertical and seasonal occurrence of the Douglas-squirrel.

David Shaw, WRCCRF. Foraging ecology of small songbirds.

David Woodruff and David Shaw, WRCCRF. Excluding birds from foliated branches: potential effect on herbivores and herbivory.

**CANOPY PROCESSES**

Allison Horner and David Dalton, Reed College. Seasonal and spatial variation of antioxidants in an old-growth Douglas-fir canopy.

Tom Hinckley, Univ. of Washington. Western hemlock response to hemlock dwarf mistletoe.

William Winner, Oregon State Univ. and David Dalton, Reed College. Analysis of carbon, nitrogen, and water use by *Lobaria* spp., a cynolichen at the Wind River Canopy Crane Site.

David Braun, WRCCRF, Bi Runcheng, Shanxi Teacher Univ., Linfen City, China, David Shaw, WRCCRF, and Mark Van Scoy, WRCCRF. Herbivory and herbivore guilds of vine maple in old-growth Douglas-fir forests.

David Shaw, WRCCRF, Elizabeth Freeman, WRCCRF, Jiquan Chen, Michigan Technological Univ., and David Braun, WRCCRF. Spatial patterns of hemlock dwarf mistletoe infections in an old-growth forest reserve.

**CLIMATE**

Trevor Newton, WRCCRF and Univ. of California, Davis. Climate of the Wind River Area during the 20th Century (1931-1977 and 1998-2000).

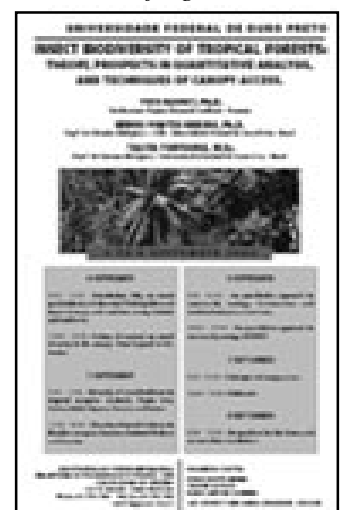
**CANOPY MEETING IN BRAZIL**

Canopy ecology in Brazil is beginning to be discussed. Two Brazilian ecologists are promoting two events in different parts of Brazil, both having the same aim: to bring to attention the importance of canopy ecology. Talita Fontoura (Universidade Estadual de Santa Cruz/Bahia) is coordinating the “First Brazilian Workshop on Canopy Ecology - Copa no Brasil” at Universidade Estadual de Campinas, Sao Paulo, July 24-27, 2000. This workshop will be the first meeting in Brazil devoted to professionals who are dealing with plant ecology, plant physiology, mammalogy, insect herbivory, and climbing techniques in the canopy. Beyond the presentation of papers in a short communication session, this workshop will explore different climbing techniques during three days in Santa Genebra Forest, one of the best known Brazilian forest remnants.

The second meeting will be held September 4-8, 2000 at Universidade Federal de Ouro Preto (Minas Gerais). Servio Ribeiro is in charge of “Insect Biodiversity of Tropical Forests: Theory, Prospects in Quantitative Analysis, and Techniques of Canopy Access”. This event will focus on insect diversity in Africa, Europe, and Brazil, dealing with its theoretical aspects. The second part of this meeting will explore community ecology and climbing techniques with field work.

We hope these two events can bring together many researchers and professionals who are investigating different parts of the same canopy.

Talita Fontoura, Univ. Estadual de Sta. Cruz, Depto Biologia, Rod Ilheus Itabuna KM 16, BA, 45650-000, Brazil; Phone: 73-680-5129/5105; Fax: 73-212-2195; <talita@jacaranda.uescba.com.br> and Servio Ribiero, Universidade Federal de Minas, Dept. de Biologia Geral/ICB, DCB/ICEB/UFOP, CEP 35. 400-000, Marro de Gruzino, Ovro Preto, MG, Brazil; Phone: 00 55-31 496-7293; <serviopr@mono.icb.ufmg.br>



## FEATURE ARTICLE

### THE CANOPY CRANE IN THE TAI-NATIONAL PARK (IVORY COAST)

The Tai-National Park, with an area of 457,000 ha, is located in the Southwest of the Ivory Coast. It represents one of the last remnants of the primary tropical forests of West Africa. The park region is known as a center of biodiversity, and was classified as a World Heritage site in 1982 by UNESCO. The forest is part of a restricted area, mostly extended into the Guinean Highlands, in which the humid forests survived during the Last Glacial Maximum.

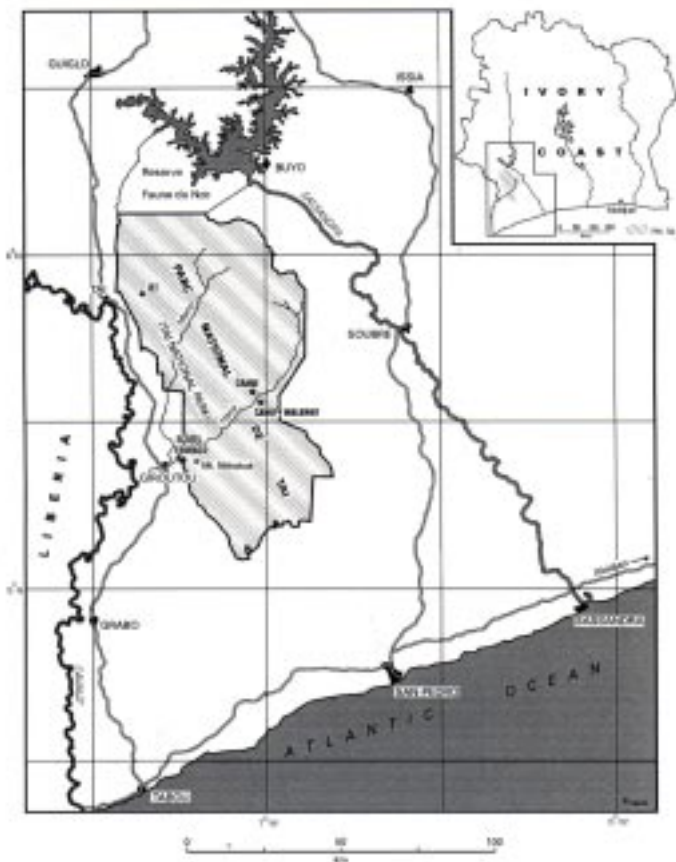
The prospective crane plot is situated 170 km north of San Pedro (350 km from the capital Abidjan), and is easily accessible by 4-wheel drive cars (Fig. 1). There is a gradation from north to south, with the southern third of the park being the moistest and richest area. The forest has a high level of endemism, with over 150 species identified as endemic to the Tai region. The fauna includes 47 of the 54 species of large mammals that inhabit the humid forest of Guinean, including five endangered species. These mammals include monkeys (mona, diana, colobus, chimpanzee), pangolins, leopards, elephants, pigmy hippopotamuses (the

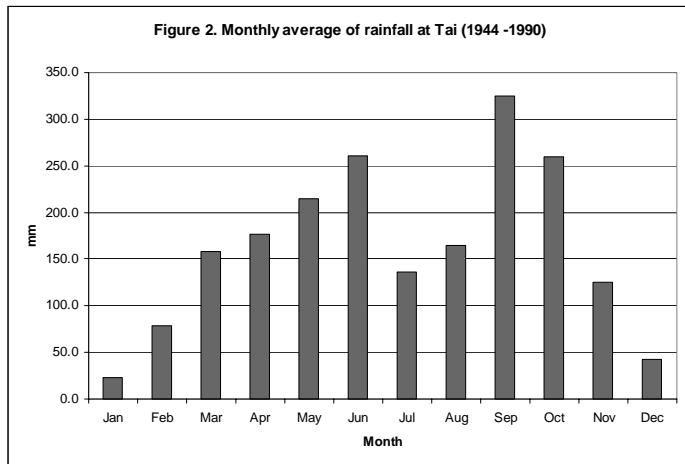
only viable population remaining in the Ivory Coast), buffalos, and a variety of forest duikers. Over 230 species of birds have been identified.

The forest is subdivided into three parts by two rivers. The central part between the Meno River and the Hana River has never been exploited for natural resources. The climate of the park is typical of the lowland moist tropics. In general, rainfall increases from the north-eastern edge of the park (1,600-1,700 mm) to the south-western edge (2,000 mm). The dry season occurs between December and February. Highest rainfall is in September during the second rainy season of the year (Fig. 2). Nine months of the year can be classified as humid months.

A research station operated by the University of Abidjan has been established near the northwestern border of the park, 20 km from the town of Tai. This station was supported financially by the UNESCO within the MAB Program (Man and Biosphere). All further research has been concentrated on this region of the park, while the eastern and southern parts were and are excluded due to access and infrastructure problems.

The population living around the park has increased during the last 30 years by more than 1000 percent, resulting in an enormous pressure on the natural resources. Since 1993, when the German-Ivorian project to preserve the Tai National Park (PACPNT - *Projet Autonome pour la Conservation du Parc National de Tai*) was established, a management plan for the park and its peripheral areas was implemented. A major part of the project's efforts are concentrated on the education of the local population and on introducing new production techniques (intensification of rice production, small scale fishery, keeping of pets, village forest management) to reduce the pressure on the park and to increase the income of the local population. These developmental and administrative activities are coordinated and carried out by PACPNT and supported financially by the GTZ (Deutsche Gesellschaft für Technische Zusammenarbeit), the KfW (Kreditanstalt für Wiederaufbau – The German Development Bank), the WWF (Worldwide Fund for Nature), TOPENBOS (Dutch foundation), the CSRS (Centre Swiss de la Recherche Scientifique – The Swiss Research Center), the DPN (Direction des Parcs Nationaux – The National Park Management), and the MINEF (Ministère de l'Environnement et de la Forêt – Ministry of Environment and Forests).





Preparations to install a canopy walkway in the forest to increase the number of visitors have been in progress for one year. These ecotourism activities should guarantee an additional income that will support the park management and increase local employment. The canopy walkway will be installed in a slightly degraded part of the Tai Forest south of the Hana River (Fig. 1). It will be financed by the KFW and the GTZ, and offers a permanent access to the canopy of this unique biotope for tourists and scientists.

Near the western border of the National Park in Guiroutou (Fig. 1), a small hotel has been built, the *Ecotel Touraco*, which has been in operation since 1999. It is a convenient place to use as a base camp, with a range of guided excursions. The most spectacular trips are a one-day journey during which one can observe chimpanzees, or a two-day trip to Mt. Niénokoué, the highest inselberg in the National Park. (Inselberg is a geomorphological term meaning a structure of granite rocks with a dome-like appearance found predominantly in the tropics.) This trip includes the ascent of the inselberg which grants a fantastic view over the western Tai Forest. After staying overnight in a small camp on the Hana River, the visitors return in a canoe.

The canopy walkway will be situated near the eastern border of the park, 35 km away from the Ecotel. Tourists will be introduced to tropical forest ecology in an information center before walking through the canopy. Special excursions will also be offered. A camp will be installed which will give one the opportunity to stay overnight. This opportunity will keep tourists in the forest for a longer period of time, which will increase the revenue of the park as well and support local employment (e.g., guides, handicraft producers, and food producers). The walkway will also play an important role for scientific work in this region. It is located in a secondary forest, which has been under protection since 1973. This enables comparative studies of primary and secondary forests.

A large area of primary evergreen forest is located 3 km away. Both forests are separated by the Hana River, which prevented the same kind of exploitation that occurred in the southern part of The Reserve. In cooperation with the park administration, Eduard Linsenmaier, Gerd Radl (ecologist working for the PACPNT), and Dieter Anhuf have chosen a site suitable for the crane (Fig.1). The crane is located in an area with about 1,800 mm annual rain fall. The crane will be financed by private funding organized by Dieter Anhuf. He hopes that the crane will be in operation by the end of 2001. Every scientist from around the world working in this field is requested to send research proposals to a scientific board, which will then coordinate the research programs at the crane site.

Any support or funding assistance would be appreciated. A color brochure will be available in July and information is available from our web-site <<[www.uni-mannheim.de/phygeo](http://www.uni-mannheim.de/phygeo)>>.

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#### BOARD OF DIRECTORS BIO-SKETCH

Kevin Hillery is a member of the ICAN board of directors. He is president of Whole Tree Works, Inc., an arboriculture firm in Portland Oregon, USA. He is certified as an arborist with the International Society of Arboriculture. Professional responsibilities include tree preservation and management plans, appraisals, hazard tree assessments, pruning, and teaching. His forest canopy activities have included locating Marbled Murrelet nests, assisting in bald eagle contamination studies and songbird predation research, teaching low-impact climbing techniques, building canopy platforms and walkways, and developing site safety plans. His hobbies include every mode of skiing and every medium of climbing. His favorite landscapes, when not in forest settings, are glaciers and frozen waterfalls.

Kevin's career in arboriculture started in 1982. He spent the first ten years learning the basics of tree health and structure and refining his pruning and climbing techniques. As his climbing skills improved he began competing and placing in tree climbing jamborees. To further strengthen his climbing abilities, he began to climb bigger and more challenging trees. This led him to the ancient forests of Washington and British Columbia. During this pursuit, he discovered other people interested in gaining access to the canopy. Today, his interests in canopy science focus on promoting safe, low-impact climbing and construction techniques and ensuring that climbers and researchers maintain an awareness of tree health and structure issues.

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**FUNDING OPPORTUNITIES**


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**Russell E. Train Education for Nature.** The US World Wildlife Fund created this program to support students in developing countries and schools that teach conservation biology. Scholarships, fellowships, and grants are awarded to committed conservationists working in their own countries to protect natural resources. There are many more conservation and endangered species grants on the website. Contact: <<<http://www.wwf.org>>>.

**National Science Foundation Graduate Research Fellowships.** The National Science Foundation (NSF) offers graduate research fellowships in order to maintain quality and reinforce diversity of researchers. Fellowships are awarded for three years of support for advanced study in the sciences, and PhD research in science education. Fellowships include both a stipend and an allowance for tuition. Contact: <<<http://www.ehr.nsf.gov/EHR/DGE/grf.htm>>>.

**The Lincoln Park Zoo** supports field work in conservation in the Neotropics and in Africa and Asia through two major funds. The Neotropic Fund supports field research in conservation biology throughout Latin America and the Caribbean. The fund emphasizes support of graduate students and other young researchers, particularly those from Latin America. Additionally, the zoo also supports field work in conservation biology in Africa and Asia through the Africa/Asia Fund. Contact: *LINCOLN PARK ZOO NEOTROPIC FUND, Department of Conservation and Science, Lincoln Park Zoo, 2001 N. Clark Street, Chicago, IL 60614; phone:(312) 742-7250; fax:(312) 742-7220; <<www.lpzoo.com/conservation>>; <conservation@lpzoo.org>*.

**The Explorers Club: Exploration Fund.** The Explorers Club provides grants of up to \$1,200 for graduate study involving scientific investigation and field research. Applicants need not be members of the club to be eligible. Contact: *The Exploration Fund Committee, The Explorers Club, 46 East 70th Street, New York, NY 10021; <<http://www.explorers.org/servicesfiles/exploration.html>>*.

**James F. Lynch Conservation Biology Fund.** In honor of the late James F. Lynch, a conservation biologist, this fund supports new scientists working in conservation biology in Central America and East Africa. Contact: *James F. Lynch Conservation Biology Fund, c/o Jeanine Robert, Smithsonian Environmental Research Center, P.O. Box 28, Edgewater, MD 21037.*

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**WEBSITES OF INTEREST**


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**Canopy Citations Database** is now available on a new high speed server. The International Canopy Network has assembled this resource for worldwide canopy research. This database contains over 1300 citations regarding canopy ecology. Users can search for authors, titles, dates, journals, keywords, or words within an abstract. The old website will continue to work until August 1, 2000. The new website for the citations database is as follows. <<[www.evergreen.edu/canopycitations](http://www.evergreen.edu/canopycitations)>>

**The New York Botanical Garden** is in the process of cataloging its 75,000 vascular plant type specimens to make available as a resource on the web. Basic information from all types in these families is included in the database. Moreover, specimens of Annonaceae, Cucurbitaceae, Cyperaceae, Elaphoglossum, Ericaceae, Lecythidaceae, Nolanaceae, New World Rutaceae, and Scrophulariaceae have been imaged and are included in the catalog. <<<http://www.nybg.org/bsci/hcol/vasc/>>>

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**MEETINGS OF INTEREST**


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**The 6th International Interdisciplinary Conference on the Environment.** Montreal, Quebec, Canada. June 21-24, 2000. The Interdisciplinary Environmental Association (IEA) and Assumption College are putting on this conference, motivated by the need to combine ideas and research findings from different disciplines to further our understanding of the interactions between the natural environment and humans. The program will consist of small seminar sessions with: chairperson, presenters, and at least one discussant assigned to comment on each paper; poster sessions; round-table discussions; workshops and panels; as well as invited speakers. Contact: *Kevin L. Hickey / Demetri Kantarelis, IEA/Hickey-Kantarelis, Assumption College, 500 Salisbury Street, Worcester, MA 01615; Phone: (508) 767-7296 (Hickey), (508) 767-7557 (Kantarelis); Fax: (508) 767-7382; <khickey@assumption.edu>; <dkantar@assumption.edu>; <dkantar@assumption.edu>; <<http://champion.iupui.edu/~mreiter/iea.htm>>*.

**World Botanic Gardens Congress: Partnerships Within and Beyond the Garden.** June 25-30, 2000. Asheville, North Carolina, USA. The American Association of Botanical Gardens and Arboreta (AABGA), Botanic Gardens Conservation International (BGCI), and the Center for Plant Conservation (CPC) will co-host the first World Botanic

Gardens Congress, to be held in conjunction with the 6th International Botanic Gardens Conservation Congress. The theme is expansion of collaborations within and among the world's botanic gardens and other sectors of the botanical and conservation societies, for the presentation, preservation, and sustainable use of the earth's plants and habitats. Contact: *Nan Guthrie, Congress Coordinator, 100 Frederick Law Olmsted Way, Asheville, North Carolina 28806-9315, USA; Phone: 1-828-665-2492; Fax: 1-828-665-2371; <congress@ncarboretum.org>; <<http://www.bgci.org.uk/>>*.

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#### ANNOUNCEMENTS

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**Smithsonian Tropical Research Institute** supports education, conservation, and research on the ecology and evolution of tropical plants and animals and humans' influence on tropical environments. It has several research facilities in Latin America as well as research sites in Latin America, Asia, and Africa. These facilities have excellent equipment, including a 40 m tower crane at one site in Panama, and are available to visiting researchers. Contact: *Visitor Services Office, Smithsonian Tropical Research Institute, Box 2072, Balboa, Rep. of Panama; Phone: +(507) 212-8026/8082/8085; Fax: +(507) 212-8148; <maggiorg@tivoli.si.edu >; <<http://www.si.edu/stri/>>*.

**The EFISCEN European Forest Resource (EEFR) database** has recently been launched by The European Forest Institute with detailed information of forest resources from 31 European countries. This database was created to make data more accessible to the public and provides contact information of the original data provider, links to the responsible national forest institutes, information on the source of the data and definitions used for the forest inventories. Contact: *Mart-Jan Schelhaas; <M.J.Schelhaas@ibn.dlo.nl>; <<http://www.efi.fi/information\_services/>>*.

**Issues in Ecology.** Ecological Society of America has made available this series of reports on ecological issues. A report on Biodiversity and Ecosystem Functioning; and Applying Ecological Principles to Management of the U.S. National Forests investigates and recommends sustainable management policies for the U.S. forests. Publications can be found online or can be ordered as hardcopies. Contact: *The Ecological Society of America, 1707 H Street NW Suite 400 Washington, DC 20006; Phone: (202) 833-8773; fax: (202) 833-8775; <esahq@esa.org>, <<http://esa.sdsc.edu/issues.htm>>*.

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#### PUBLICATIONS OF INTEREST

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**Maintaining Biodiversity in Forest Ecosystems.** **Malcolm L. Hunter (ed.). 1999. ISBN: 0521631041.** This book explores how humans can continue to benefit from forests, while maintaining biological diversity in all its forms. Contact: *Cambridge University Press, 110 Midland Avenue, Port Chester, NY 10573-4930, U.S.A.; Phone: 914-937-9600; Toll free in the U.S.: 800-872-7423; Fax: 914-937-4712; <<www.cup.org>>*.

**Monteverde: Ecology and Conservation of a Tropical Cloud Forest.** N.M. Nadkarni, N.T. Wheelwright (eds.). 2000. ISBN: 019509560X. This book provides a broad introduction to the biology of high-altitude tropical rain forests. The authors discuss the diverse habitats, organisms, and interactions in primary and human-affected landscapes of the Monteverde Cloud Forest Reserve, 12,000 ha of protected montane cloud forest. In addition to exploring the ecosystem and its biota, the book also examines the effects of humans on the forest and its surrounding communities. The main goal of the authors is to bring together the extensive body of knowledge that exists and to identify areas for future research. Over 125 ecologists, agriculturists, and educators have contributed to this compilation of research to promote further research in ecology and conservation. Contact: *Oxford University Press, Inc. 198 Madison Ave. New York, NY 10016; Phone: 1-800-445-9714; Fax: 1-919-677-1303; <mbj@oup-usa.org>; <<http://mnemosyne.oup-usa.org/docs/019509560X.html>>*.

**Climate, Biodiversity, and Forests: Issues and Opportunities from Kyoto Protocol.** **P. Brown 1998. ISBN: 1-56973-285-x.** This report considers the role of forests and land use in the protection of the earth's climate and biodiversity, just as policymakers prepare to implement the limits on greenhouse gas emissions called for in the 1997 Kyoto Protocol. The report focuses on the ways in which forests and land-use change can both exacerbate and mitigate climate change. Prepared in collaboration between World Resources Institute and IUCN-The World Conservation Union, it not only identifies opportunities the Protocol presents for the conservation, improved management, and restoration of forests, but also explains why the role of forests has proved controversial. Contact: *World Resources Institute Publications, PO Box 4852, Hampden Station, Baltimore MD 21211; Phone: 1-800-822-0504; Fax: 410-516-6998; <publications@wri.org>; <<http://www.wristore.com/>>*.

## 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 monthly literature searches (AGRICOLA, CAB, and FORESTRY ABSTRACTS).

### CANOPY INVERTEBRATES

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- Berkov, A., & G. Tavakilian. 1999. Host utilization of the Brazil nut family (*Lecythidaceae*) by sympatric wood-boring species of *Palmae* (Coleoptera, Cerambycidae, Lamiinae, Acanthocini). *Biological Journal of the Linnean Society* **67**:181-198.
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