



# WHAT'S UP?

## The Newsletter of the International Canopy Network

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### ICAN MOVES FORWARD WITH MEMBER INPUT AT THE 2ND ANNUAL CANOPY CONFERENCE

The International Canopy Network had a strong presence at the 2nd International Canopy Conference at The Marie Selby Botanical Gardens in November, 1998. Amber Neilson, Educational Coordinator of the ICAN, was present at an ICAN booth and display, answered questions, distributed literature, sold ICAN tee-shirts and "epi-jewelry", and signed up new members throughout the meeting.

The ICAN also held an informal meeting, in which we reported progress on past and current projects, as well as solicited ideas for new directions. Three of the seven ICAN Board members were present at the meeting (N. Nadkarni, J. Clement, D. Shaw), and approximately 35 people attended. Updates on current projects and suggested new activities included the following:

#### RESEARCH

**Graduate program:** We discussed the perceived growing need for a coordinated graduate program in canopy studies. Although efforts to obtain funding for such a program have been made twice in the past, the growing field, increased interest in it by policy makers, and the large number of potential graduate students being attracted to the field suggests that the time is ripe to revitalize those efforts, and perhaps expand fund-raising efforts to private foundations. The vision of a "university without walls" was discussed, and a number of senior researchers at academic and research institutions expressed interest in serving as mentors for this program. N. Nadkarni will draft and circulate a preliminary proposal on the email network.

**Circulation of canopy research databases:** The ICAN office is making available two scientific citation databases; one on canopy structure and one on epiphytes. Other such databases on subjects related to canopy studies are welcome. Contact the ICAN office if you have one available.

#### EDUCATION

**Kit program:** ICAN Board Member Maureen McConnell suggested at the most recent Board of Directors meeting (September 1998) that educational "kits" on canopy studies would be an effective and cost-efficient way of transmitting information about forest canopies to school children. ICAN could work as a partner with an informal science education institution such as the Boston Museum of Science or the National Geographic Society to assemble and distribute canopy-related videos, CDs, teachers' guides and other materials. A grant proposal will need to be written and funded to underwrite the costs of such a program, but many of the materials that should be included already exist.

**Companion website for canopy film:** Working with the National Geographic Society and the filmmakers of the new television film, *Heroes of the High Frontier*, ICAN has compiled a "companion" website that accompanies the airing of this prime-time television film. The film will be seen by more than 50 million viewers around the world; by clicking onto the National Geographic's web site (which is listed in the film credits), viewers can link to our companion site. We have provided in-depth scientific information about the organisms and interactions that are shown in the film, offering links to conservation resources, individual researchers publications, and curriculum vitae, and suggestions for ways of finding out more about the subjects.

#### ARBORICULTURE AND ACCESS

**DOA program:** Several participants called for ICAN to establish a survey/database for injuries to humans or trees as a result of climbing. This will be a way of providing insurance companies with realistic statistics on the safety of tree-climbing, as well as offering climbers information on activities to avoid and how to avoid them. The American Alpine Climbers has an accident database, and provides an

excellent model for such a program. For damage to trees, such information as date and cause of damage, ways of avoiding damage, and a followup on recovery of the tree would be useful. For accidents to humans, such information should include: how many hours the climber had been climbing, the experience level of the climber, and the climatic conditions. ICAN will initiate the new "DOA" (Damage or Accidents) program, and will send a survey to members over the email bulletin board.

**Clearinghouse for information on canopy structures:** Several participants suggested that ICAN could provide a link between providers and clients needing structures within forest canopies (e.g., platforms or walkways for research or education purposes). A few companies have already established themselves in this construction niche, and it would be helpful to have their climbing and safety records easily available. Experienced builders may eventually be able to offer apprenticeships.

**Certification program:** Dave Shaw, ICAN Board member and Director of the Wind River Canopy Crane Facility, suggested the need for developing a tree-climbing certification program. At his facility, for example, many researchers conduct studies with very little knowledge about climbing safety protocol. This is a liability to the researchers and the institutions. To avoid this becoming a required "credential" that might exclude those who do not have access or funding to get certified, this was recommended to be a resource, rather than a requirement. The program could "train tree-climbing trainers", who could then teach individuals how to climb through an agency or research facility. SCUBA diving is a good model for this concept - where there are different standards for researcher vs. recreational divers.

## CONSERVATION

**Communication with policy-makers:** The Union of Concerned Scientists (UCS, Cambridge, Massachusetts) works to bring together scientists with policy- and decision-makers on topics of interest to the public. Two of their issues of interest are global climate change and biodiversity. Aspects of canopy research address both of these issues, and therefore the ICAN could get involved directly with the UCS. The possibility of bringing decision-makers to the canopy was discussed. ICAN will be in contact with people at UCS to learn what direct actions we might pursue.

**Adopt-a-canopy:** In response to a call for help in constructing a research walkway in the Camerouns, Eric Bolen suggested that ICAN initiate an "Adopt-a-Canopy" program. Based on scientifically sound input from canopy researchers, we could establish a set of conservation priority criteria that would maximize the conservation values of particular for-

ests. This information could be channeled to fund-raising and conservation groups, and particular forests could be purchased, protected, or provided with research funds.

## ICAN LOGISTICS AND COMMUNICATION

**ICAN website:** The ICAN staff has been updating and expanding our website ([www.evergreen.edu/ican](http://www.evergreen.edu/ican)). Please take a look and send us your curriculum vitae, list of publications, links to other sites, or other suggestions.

**Call for international advisory board:** Joel Clement, ICAN Board Member, called for expanding the input and oversight available to ICAN by establishing an international advisory board. This would serve to diversify and broaden the base of expertise of our current Board of Directors. Meetings of the advisory board would be by electronic or regular mail, as no funds are available to have centralized meetings. Several suggested that we have board meetings that "piggy back" on to international meetings where at least some of the Board members will be present. If you have nominations or suggestions for the Advisory Board, please let the ICAN office know.

## OTHER IDEAS

Other ideas that were deemed of interest but which were not pursued in depth included the standardization of research techniques, international funds to bring US citizens to foreign countries for meetings and collaborative research, and specific foundations which might fund ICAN activities.

In summary, the meeting was a productive and positive time for generating new ideas and interest in our organization. Thanks to everyone who enthusiastically participated in contributing to ideas. We welcome your reactions and suggestions and look forward to working with the greater canopy community towards developing ICAN resources.

*Nalini Nadkarni, ICAN President, The Evergreen State College,  
<nadkarnn@elwha.evergreen.edu>.*

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## ICAN TEE-SHIRTS AVAILABLE!!

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ICAN now has tee-shirts available. These shirts are made of 100%, high-quality cotton, are short-sleeved and have the ICAN icon printed on the front left of the shirt. They are available in two colors, ash and natural (off-white), and four sizes (small, medium, large and x-large). The shirts are US \$12.00, plus US \$2.00 shipping and handling for each shirt. Send check, money order, or credit card information (number, expiration date, and type of credit card) to the address located on the back cover of this newsletter.

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## SECOND INTERNATIONAL CANOPY CONFERENCE: A SUCCESS

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The Marie Selby Botanical Gardens hosted a wonderfully interactive conference of researchers, educators, conservationists, and policy makers concerned with forest canopies. Over 250 participants, who travelled from over 35 countries, spent an active four days communicating their latest research news, educational opportunities, and conservation priorities.

Many were graduate students and international visitors who were supported from a conference grant from the National Science Foundation awarded to Meg Lowman, the conference co-ordinator. Funds were raised from a variety of other private sources, and the Selby Gardens staff and volunteers supported the complex logistics with grace and efficiency. Many of the international visitors were hosted by local families.

The papers and poster sessions provided the venue for exchange of research results. Lively dialogue at all of the poster sessions, as well as active questions and answers during the oral sessions, were evidence of strong interest in the latest-breaking results among canopy researchers. Policy makers also had input during the conference; Bill Brown, of the Department of the Interior gave a well-received talk on the important role of forest canopy science as an integral aid to helping with land use decisions and policy concerning forest ecosystems.

Education was a strong theme of the conference, with the entire first day of the conference devoted to hands-on interchange with local school children in "Canopy Career Day" activities. Other hands-on activities included demonstrations of many kinds of canopy access equipment and techniques including the "canopy sled", which has been developed by the "Operation Canopy" group in Montpellier, France. The inflatable sled was hung in a huge banyan tree on the Selby Gardens grounds, and young and old gained the experience of hanging aloft on this unique canopy access apparatus.

Films on the canopy were shown continually, art displays were held, and tours of the extensive collections of epiphytes and other tropical plants for which Selby Gardens is renown, were provided. Evening lectures by Dr. Don Perry and Dr. Mark Moffett were offered to the participants and to the general public. A highlight of the conference was the premiere of the National Geographic film on tropical canopy research, *Heroes of the High Frontier*, which was introduced by its director/producer, Tim Scoones.

The canopy community appreciates the hard work and huge amounts of time and logistical energy that went into the success of this conference. The co-convenors, Meg Lowman and Francis Hallé, deserve warm thanks from us all. The positive outcomes it produced by facilitating communication of research results among educators, scientists, arborists, policy makers, and the general public, especially children, will resonate long into the future.

*Nalini Nadkarni, ICAN President, The Evergreen State College, <nadkarnn@elwha.evergreen.edu>.*

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### SUMMARY OF THE WORKSHOP ON DATABASES IN CANOPY RESEARCH AT THE CANOPY CONFERENCE

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Co-moderators: Nalini Nadkarni and Geoffrey Parker

The Workshop on Databases in Canopy Science was intended to: 1) review the several efforts by Nadkarni, Parker and others to provide database tools for canopy sciences, 2) indicate the current state of those efforts, including the obstacles and success, and, 3) get a sense of the community interest in further progress. About 40 people attended this workshop.

Nadkarni described the history of several projects concerning databases in canopy science, from the original National Science Foundation grant to Nadkarni, Parker, and D. Ford. Many of the results of the project, though not focused entirely on the database issues, were useful and continue to bear fruit (networking, outreach, enhancing the visibility of canopy studies). However, the project provided relatively few tangible results in the form of new database tools generally useful to the canopy research community. A variety of obstacles to this were identified over the course of the projects, including non-overlapping disciplinary focus, sizes of project, and conceptual differences concerning canopy structure and function. Relatively few areas of canopy research have managed to overcome these (largely social) hurdles. Because the informatics activity ultimately reflects the science, a database cannot become a truly integrative tool until the problems of integrating the science are met.

Parker also noted that the project results were mixed. On the one hand, we learned a lot about the "database process" and discovered (after some resistance) that database and informatics researchers have much to offer in understanding of the context of numbers, the treatment of numbers, the "personality" of data, a need to recognize who takes the numbers, and how and by whom they are to be used. The potential power of this emerging field has not been well-utilized in canopy science. We also discovered a wealth of scientific visualization software tools used in other disciplines for

displaying information about complex structures, processes, and datasets.

Unfortunately, the best of these were very domain-specific and not easily portable to other disciplines. Nonetheless, it is very likely that such tools could be applied to yield new understanding about canopies. On the other hand, we found few examples of database or visualizations applications in canopy science that were general, non-trivial, and capable of bringing together formerly disparate viewpoints or information.

Generally, the importance of database structures and the cost of not implementing them were seen to rise with the scope of the project, while the costs to the individual researcher fell. For individual researchers with a site-specific focus and question, a large investment in databasing may be cost-ineffective. On the other extreme, "Big Science" database activities are often integral to the activity, included from the inception, and thus the question of database utility may be irrelevant. Between these extremes are cases where the introduction of suitable database could have relatively great benefits and lower costs.

In the discussion, it was agreed that additional effort was warranted for efforts to produce a database for such intermediate cases, particularly for "collaborative" efforts such as those represented by the crane sites. Nadkarni agreed to draft a proposal outline that would focus on such issues.

*Summarized by Geoffrey G. Parker, Smithsonian Environmental Research Center, P.O. Box 28, Edgewater, MD 21037  
<parker@serc.si.edu>*

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## THE ASSOCIATION FOR WOMEN IN SCIENCE: A CALL FOR PAPERS

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The Association for Women in Science (AWIS) Magazine is accepting manuscripts for consideration in the issues that will be coming out in 1999. Themes for next year include:

- \* Science as exploration: women scientists in the field
- \* Career vs. home: The professional and social decisions of women scientists
- \* Higher education: an institution in flux

In addition, general articles about women, science, and other related issues are published. All are encouraged to contact the editor with ideas, abstracts, and manuscripts.

Contact: *Susan L. Ganter, Editor, AWIS Magazine; Phone: 202-293-6440 extension 32; <sganter@aahe.org>*.

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## BREAKING NEWS FROM DOWN UNDER

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The Australian Canopy Crane is in place! After two years, we're in business. The crane was lowered by helicopter into the lowland tropical rainforest at Cape Tribulation, 140 km north of Cairns on November 17, 1998.

One of the first projects planned for the crane will be coordinated by Dr. Steve Turton, a researcher with the Rainforest Cooperative Research Centre and the James Cook University. Steve will record micrometeorological data at the site, and this will be available for other researchers to use for their own projects. Steve will install meteorology equipment on the crane tower and in the adjacent rainforest. Vertical micrometeorological instrumentation will be attached to the crane tower at heights of 50 m, 30 m and 10 m. This instrumentation will take half-hourly readings of the following meteorological parameters:

- \*photosynthetically active radiation
- \*wind velocity and direction (at 50 m only)
- \*air temperature
- \*relative humidity

An automated weather station has been placed in a large clearing 500 m from the crane site to measure wind velocity and direction, rainfall, air temperature, soil temperature at 10 cm, soil moisture at 10 cm, relative humidity, solar radiation, and leaf wetness. A Bowen Ratio System will be added to the crane tower in early 1999, to measure forest canopy heat and evaporation exchanges.

If you would like to discuss any aspects of the canopy crane, or propose a research study, contact: *Professor Nigel Stork, Phone: +61 7 4042 1246; <crctrem@jcu.edu.au>; <<www.cimm.jcu.edu.au/netshare/rainforestCRC/>>*.

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## CANOPY HEROES ON THE AIR

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*Heros of the High Frontier* is an exciting presentation of four ecologists and their studies in the canopy of tropical forests. From raptors to orchids to fungi, this film engages the onlooker into a world of awe and intrigue in the tops of the trees. The film will be shown on NBC's prime time television on January 30, 1999, 8-9 pm EST.

NBC Dateline, a prime time news magazine program, will air an interview with Nalini Nadkarni about the making of the film, the day before (January 29).

The ICAN has produced a "companion website" for this film. Check it out on the ICAN website ([www.evergreen.edu/ican](http://www.evergreen.edu/ican)) and click on "Heroes of the High Frontier".

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**ANNOUNCEMENTS**


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**Focus on Ecologists**

In July, the Ecological Society of America unveiled a new feature on its website aimed at highlighting the types of careers in which ecologists are engaged and also the variety of individuals drawn to the science. Entitled "Focus on Ecologist", <<esa.sdsc.edu/ecologistsdo/htm>>, the webpage introduces the reader to six ecologists with a variety of backgrounds and interests, describing what first inspired their interest in ecology and their career focus. Following up on one of the key recommendations made in the *Women and Minorities in Ecology* report, the page is part of an ongoing project to introduce web visitors to the options available to students interested in ecology. New profiles will be added periodically. For information, or to offer comments and suggestions, contact: *Susan Musante*, Phone: (202) 416-6186; <susan@esa.org>.

**Forest Fragmentation Videos**

Colorado State University has produced three videos on forest fragmentation in the Central Rocky Mountains of Colorado and Wyoming. The videos are titled: "Human Causes of Forest Fragmentation in the Central Rocky Mountains" (30 minutes), "Natural Causes of Forest Fragmentation in the Central Rocky Mountains" (31 minutes), and "Biodiversity Responses to Forest Fragmentation in the Central Rocky Mountains" (32 minutes). The videos feature excerpts by Dennis Knight, Bill Baker, Tom Veblan, Rick Knight, and others, who presented papers during a conference at Colorado State University. Each video costs \$10 for duplication and shipping.

Orders: *The Office of Instructional Services, Colorado State University, A71 Clark BLDG, Fort Collins, CO 80523; (970) 491-1325.*

**The Tree Conservation Database**

This database was used to generate *The World List of Threatened Trees*. It is an interactive database on threatened tree species and other trees of conservation concern. Graphs and datasets are also included in the resource. The database is available at <<www.wcmc.org.uk/trees/>>.

**CIDA Forestry Advisors Network**

The CIDA Forestry Advisors Network (CFAN) has recently posted two new papers on its website: a project profile that describes the PAGS natural resources management project in Honduras (available in French, English, and Spanish) and a description of the CFAN network. For more information, check out the website; <<www.rcfa-cfan.org>>.

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**PUBLICATIONS OF INTEREST**

**Shadows in the Forest: Japan and the Politics of Timber in Southeast Asia.** P. Dauvergne. 1997. This book examines Japan's effect on commercial timber management in Indonesia, East Malaysia, and the Philippines. Orders: *MIT Press; 1-800-356-0340. Code: 8ENV.*

**Orchids: Status, Survey, and Conservation Action Plan.** A.M. Pridgeon, E. Hagsater, and V. Dumont, eds. 1996. IUCN Publications. ISBN: 2-8317-0325-5. Orders: *Island Press, P.O. Box 7, Dept. 3NS, Covelo, CA 95428; Phone: 800-828-1302.*

**Non-Timber Forest Products: Ecological and Economic Aspects of Exploitation in Columbia, Ecuador, and Bolivia.** G. Broekhoven. 1996. IUCN Publications. ISBN: 2-8317-0308-5. Orders: *Island Press, P.O. Box 7, Dept. 3NS, Covelo, CA 95428; Phone: 800-828-1302.*

**A Rapid Assessment of the Humid Forests of South Central Chuquisaca, Bolivia.** T.S. Schulenberg and K. Awbrey. 1998. ISBN: 1-881173-1-94. Orders: *The University of Chicago Press, 11030 South Langley Avenue, Chicago, IL 60628; Phone: 773-702-0279.*

**Environmental Databases.** ECOCARTÒ compiled this publication from various databases for GIS, printed maps (including explanatory booklets), and scientific books and studies from European researchers published by the International Center for Environmental Scientific Resources. From Afghanistan to Venezuela, and agronomy to vegetation, these databases are available on CD-Rom from: ECOCART, 6, Impasse Couzinet, 31500 Toulouse-FRANCE; <<www.ecosart.com>>.

**Australian Tropical Rain Forest Trees and Shrubs.** B.P.M. Hyland, T. Whiffin, D.C. Christophel, B. Gray, R.W. Elick, and A.J. Ford created an interactive identification system on trees and shrubs of northern Australian rain forests. The CD-Rom covers 1733 species of trees and shrubs with detailed images of flowers, fruit, leaf x-rays and plant structure. A sixty page manual is also included. ISBN: 0-643-06047-2. Orders: *CSIRO Publishing, Australia, PO Box 113-9, Collingwood, Victoria 3066, Australia. <sales@publish.csiro.au>.*

**Tricks of the Trade: How to Think About Your Research While You're Doing It.** Howard Becker. 1998. Orders: *The University of Chicago Press, 11030 South Langley Ave., Chicago, IL 60628, USA; <<www.press.uchicago.edu>>.*

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## FEATURE ARTICLE: REPORTS FROM THE 2ND INTERNATIONAL CANOPY CONFERENCE

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Editor's note: The research summaries below were selected from papers and posters presented at the 2nd International Canopy Conference, The Marie Selby Botanical Gardens, Nov. 4-8, 1998. Detailed information can be obtained by contacting the senior authors. A full set of abstracts from the conference is available from Meg Lowman, Conference Coordinator, <lowman@virtu.sar.usf.edu>.

### DO ANTS CONTROL GALL MIDGES IN NEOTROPICAL CANOPIES?

The authors studied two canopies of the widely distributed Amazonian tree, *Goupia glabra* (Celastraceae), at heights of 38 m and 45 m near Manuas, Brazil. They fogged the trees with 1% natural pyrethrum at intervals of 6 or 24 months from 1991 to 1994. Hymenoptera (mostly Formicidae) and Diptera dominated. A total of 95 ant species occurred in a single tree. Most ants foraged permanently in the canopy. Their recolonization after fogging seemed to follow stochastic pathways. The capture data indicated a biotic interaction primarily between predacious ants and gall midges (Cecidomyiidae) and secondarily between gall midges and parasitic Hymenoptera. Data from tree canopies of a lowland floodplain forest suggest that a low number of ant species might result in a reduced predation of Cecidomyiidae galls by ants, which would favor an interaction primarily between the parasitic Hymenoptera and the gall midges.

*Joachim Adis, Max Planck Institute for Limnology, Tropical Ecology Working Group, Pleon, Germany, <adis@mpil-pleon.mpg.de>; Ana Y. Harada, Museu Paraense Emilio Goeldi, Brazil; José A. Rafael, Instituto Nacional de Pesquisas da Amazônia (INPA), Belém/PA, Brazil; Stefan Vidal, Institute for Phytopathology and Applied Zoology, Justus-Liebig-University, Giessen, Germany.*

### WATER BUDGET OF THE SURUMONI CRANE SITE, VENEZUELA

Components of the water budget were investigated within a primary Amazonian rainforest in southern Venezuela at the Surumoni crane project. The annual interception loss from the forest is 17% of gross precipitation, a value greater than that reported from the Reserva Ducke forest near Manaus, Brazil (10%). The monthly amounts of transpiration range below comparable values from other studies. Transpiration was measured for eight tree species with the constant-heating method. Highest values of daily transpiration were reached by the trees of the canopy group, *Goupia glabra* and *Qualea trichanthera* (50-60 kg per day). Daily totals of those species growing in the understory, however, are much lower (2.4-23 kg per day). Canopy trees contribute to 70-80% of total transpiration. The highest amounts of transpiration loss were recorded at the beginning of the dry season in 1997. During the dry season, changes in soil-water storage were responsible for a decrease of transpiration. Immediately after the first rains in March 1998, transpiration rates again increased. These data provide information about the physiological response of the trees with regard to the effects of various environmental parameters.

*Dieter Anhuf and R. Rollenbeck, Department of Physical Geography, University of Mannheim, Germany, <anhuf@rumms.uni-mannheim.de>.*

### ARBOREAL ORIBATID MITES DIVERSITY AND RATES OF CANOPY COLONIZATION IN A MONTANE FOREST

We investigated the micro-arthropod species inhabiting the montane forest canopy from three elevations on Vancouver Island, British Columbia, Canada. We placed sterile litter bags filled with fir needles in the canopy and on the ground beside nine randomly chosen amabilis fir (*Abies amabilis*) trees to determine the composition and diversity of micro-arthropods that colonize needle litter microhabitat, quantify the colonization rates of canopy micro-arthropod groups (specifically oribatid mites), and compare the rates of needle litter decomposition between the ground and canopy at different elevations. Arthropods were collected after a 60, 120 and 360 day period and extracted using a modified Lussenhop method, counted, and identified to order. Acari, Collembola, and Psocoptera were dominant. Two-way analysis of covariance showed that ground/canopy colonization rates were significantly different, with similar patterns of colonization occurring over time for all groups. Colonization and decomposition rates were lower for most taxa at the high elevation sites, and lower in the canopy than on

the ground. Most micro-arthropod taxa showed different patterns of colonization across elevations. These experimental substrates contribute to our understanding of the biology of soil organisms inhabiting the lichen-rich canopy of montane *Abies amabilis* trees.

*Laura Fagan and Neville Winchester, University of Victoria, British Columbia, Canada, <lfagan@uvic.ca>.*

#### **HERBIVORY AND ARTHROPOD ABUNDANCE ACROSS A LONG AGE GRADIENT IN THE HAWAIIAN ISLANDS**

The Hawaiian Islands are an outstanding natural laboratory for ecological studies. The islands form a replicated time series where many ecosystem state and community factors are remarkably constant along a gradient of underlying volcanic substrate age (300 yr-4.1 million yr). Arthropod lineages are conserved among sites and the canopy is dominated by a single tree species, *Metrosideros polymorpha* (Myrtaceae). In 1997, free-living arthropods were sampled from *M. polymorpha* with pyrethrum fogging at 4 sites on 3 islands. In 1998, mature sun leaves were taken from the same 41 trees. Damage due to the dominant herbivorous guild (a species complex of gall-forming psyllids) was measured. Total arthropod densities were highest at sites of intermediate age, Kohala (150,000 yr) and Molokai (1.4 million yr), closely tracking the productivity and foliar nutrient trends across the islands. However, herbivory was significantly lower at the Molokai site (1.4 myo), but was not related to foliar nitrogen concentrations, foliar morphology, tree size, canopy cover, or cardinal aspect. Due to recent anthropogenic impacts, densities of insectivorous birds are also low at the Molokai site, which could trigger an increase in invertebrate predators and a top-down trophic cascade.

*Daniel S. Gruner, University of Hawai'i, Dept. of Zoology, Honolulu, Hawaii, <dgruner@hawaii.edu>.*

#### **ECOPHYSIOLOGY OF CANOPY LEAVES - CONSTRAINTS ON RESOURCE ALLOCATIONS IN TIME**

Canopy trees are the dominant components of forest communities, but they may face seasonal limitations in resource supply. In a seasonal tropical forest, the rainy season is a time of limited solar radiation, while the dry season is a time of limited water. Mineral nutrient availability in soil tends to decline gradually through the rainy season. Phenology of leaf production and loss may be understood through seasonal changes in resource supply rates. Observed seasonal changes of leaf nitrogen concentration, leaf mass per area, and leaf photosynthetic capacity support this perspective. Although life history and tree growth rate are a strong determinant, longevity of individual leaves is not fixed for a species, but is variable and constrained by branch architecture, phenology of crown development, and within-crown microenvironment. How rapidly leaf photosynthetic capacity declines with leaf age is an integrated result of optimization strategies, and is the most direct physiological predictor of the longevity of a leaf.

*Kaoru Kitajima, Stephen S. Mulkey, and S. Joseph Wright, Department of Botany, University of Florida, Gainesville, Florida, and Smithsonian Tropical Research Institute, Balboa, Panama, <kitajima@botany.ufl.edu>.*

#### **CANOPY ARTHROPODS OF TEMPERATE CONIFEROUS AND BROADLEAVED TREES: A COMPARATIVE STUDY**

The canopy fauna of four coniferous tree species were compared with the fauna of four deciduous broad-leaved species. Sampling was carried out with a pyrethrin knockdown chemical. Density, biomass, and species richness data were standardized to 1 m<sup>2</sup> ground area.

Quantitative analyses confirm that the canopies of conifers and broad-leaves support defined and very different communities. Mean densities and biomass of arthropods were significantly higher for conifers ( $P < 0.001$ ). Conifers supported substantial communities even when species were non-native. Both coniferous and broad-leaved groups of trees were dominated by organisms with small body sizes.

Conifer communities were dominated by the scavenger/epiphyte feeder guild, whereas broad-leaved trees were dominated numerically by phytophages. Qualitative comparisons to other studies in temperate and tropical regions showed some similar patterns, although ants were more significant in the latter habitats. Plantation communities in the UK were dominated by the same invertebrate groups as old-growth Sitka spruce in Canada. However, individual species were less likely to be canopy specialists. We hypothesize that because of observed differences in guild structure, the dynamics of conifer communities are predominantly influenced by abiotic factors, whereas broadleaf community function is more likely to be determined by biotic interactions.

**Feature Article continued....**

The species richness of the epiphyte feeders and predators was comparable for conifers and broad-leaved trees, but the richness of herbivores was greater on the latter. Woodland specialist species were found in the conifer communities. Scots pine supported a particularly rich and dense fauna, making it a valuable plantation species for enhancing canopy arthropod diversity. Canopy community structure thus varied between tree species and across seasons, but assemblages had a similar guild structure within tree group.

*Claire M.P. Ozanne, School of Life Sciences, Roehampton Institute, London, UK. <c.ozanne@roehampton.ac.uk>*

**CANOPY ECOLOGY: A HIGH PRIORITY LINK BETWEEN RESEARCH AND EDUCATION**

Scientists studying forest ecology have long craned their heads skyward and wondered about the mass of photosynthetically active foliage and biomass that make up the tree crowns. Treetop research has exploded in the last decade with the development of canopy walkways, towers, cranes, ropes, and airships that grant relatively easy canopy access to researchers, educators, and students.

Although scientists are just beginning to comprehend the complexity and richness of forest canopies, it is clear that forest canopies harbor the greatest biodiversity of any habitat in the world. In a sense, forests are like great stands of lollipops with their sugars and flavors high off the ground. Thus, most organisms dependent upon those sugars also occur high off the ground. How can canopy research be utilized in the face of the environmental problems such as species declines, human overpopulation, and habitat fragmentation?

Canopy research is crucial for the education of young people. Students are interested in treetop studies because important contributions can be made to the scientific field. Canopy research, married to education, provides a valuable opportunity to increase awareness of ecological issues and to support successful conservation efforts. Two successful models for collaborative work among scientists, educators, and students in the treetops exist: The Children's Environmental Trust Foundation, International (Zeeland, Michigan) and Millbrook School (New York State's mid-Hudson Valley). These provide opportunities for canopy access and research in temperate and tropical forests.

*H. Bruce Rinker, Millbrook School, Millbrook, NY.  
<hbrinker@millbrook.org>*

**THE MULTIBAND VEGETATION IMAGER (MVI)**

A new ground-based canopy imaging system, designed for measuring plant canopy non-randomness and other architectural components, has been developed using a 16 bit (65535 gray scale levels) charged-coupled device (CCD) camera that captures images of plant canopies in two wavelength bands. This system is referred to as a Multiband Vegetation Imager (MVI). The CCD camera is equipped with a filter exchange mechanism, controlled by a laptop computer and powered in the field by a DC to AC power inverter and a 12 V, 33 amp-hour sealed lead acid battery, which makes the system portable. The use of two wavelength bands (visible 400-620 nm, and near-infrared 720-950 nm) permits identification of sunlit and shaded foliage, sunlit and shaded branch area, clouds, and blue sky based upon the camera's resolution, and the varying spectral properties that scene components have in the two wavelength bands. This approach is different from other canopy imaging methods (e.g., fisheye photography) because it emphasizes measuring the fraction of an image occupied by various scene components (branches, shaded leaves, sunlit leaves) under different sky conditions, rather than simply the canopy gap fraction under uniform sky conditions. The MVI was used during the BOREal Ecosystem Atmosphere Study (BOREAS) in aspen, balsam poplar, jack pine, and black spruce forests to estimate architectural characteristics of each canopy and other deciduous canopies: sugar maple in Northern Wisconsin, and an oak-hickory forest in North Carolina.

The leaf area index (LAI), sunlit LAI, leaf angle distribution, and degree of non-randomness are architectural properties that have been characterized with the MVI in aspen forests. In studies of boreal forest architecture using the MVI, branches were shown to be preferentially shaded by other non-woody elements (e.g., shoots or leaves) in both coniferous and deciduous species. The spatial relationship of branches and photosynthetically active foliage was studied to estimate the fraction of the effective branch hemi-surface area index that is masked by leaves and shoots. Using a crown-based Monte Carlo model for non-random canopies, non-randomness factors (clumping factors) were also calculated from MVI data using gap-size distribution theory to correct total and sunlit LAI estimates obtained via indirect methods.

*Contact: Dr. Christopher J. Kucharik, University of Wisconsin-Madison, Department of Soil Science, 1525 Observatory Drive, Madison, WI 53706, USA; <kucharik@bob.soils.wisc.edu>*

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**MEETINGS OF INTEREST**

**Change and Disturbance in Tropical Rain Forests in South East Asia;** January 20-21, 1999; London, UK. Contact: *Science Promotion Section, The Royal Society, 6 Carlton House Terrace, London, UK. SW1Y5AG;* <www.roualoc.ac.uk>.

**Eco-agro-urban visions: New structures integrating architecture and nature;** March 4-6, 1999; University of Hawaii at Manoa, Hawaii. This meeting offers an interdisciplinary workshop on envisioning new urban models that integrate human settlement and economic production within preserved or rehabilitated natural ecosystems. Abstracts of papers, research documentation, design studies, and materials related to the workshop theme and objectives are welcomed. Proposals are due by January 15, 1999. See the website <<sundial.arch.hawaii.edu/cpi/conference.html>>, for details on length and format guidelines. Contact: *Peter Anderson, Director, Construction Process Innovation Laboratory, University of Hawaii School of Architecture, 2410 Campus Road, Honolulu, HI 96822;* <peterand@hawaii.edu>, or *Nalini Nadkarni, Lab II, The Evergreen State College, Olympia, WA 98505;* <nadkarnn@elwha.evergreen.edu>.

**Wilderness Science in a Time of Change;** May 23-27, 1999; Missoula, Montana, USA. Contact: *Clare Kelly, Natural Resource Management Division, Center for Continuing Education, The University of Montana, Missoula, MT 59812;* <ckelly@selway.umt.edu>.

**Tropical Restoration for the New Millennium;** May 23-28, 1999; San Juan, Puerto Rico. Co-sponsored by the Society of Ecological Restoration, the International Union of Forestry Research Organizations, University of Puerto Rico, and held jointly with the 4th Annual Puerto Rico Forestry Conference. Contact: *J. Parrotta, International Institute of Tropical Forestry, USDA Forest Service, PO Box 25000, Rio Piedras, PR 00928-5000, USA;* <j\_parrotta@upr1.upr.slu.edu>.

**International Symposium on the Biogeography of Madagascar; Diversity and Endemism in Madagascar - Endemic Centers and Priorities of Conservation;** August 31–September 2, 1999; Paris, France. Contact: *Dr. Wilson R. Lourenco, Laboratoire de Zoologie, Musée National D'Histoire Naturelle 61, rue de Buffon, 75005. Paris, France;* <arachne@mnhn.fr>.

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**COURSES OF INTEREST**

**Ecosistemas Amazónicos.** May 10 – June 7, 1999. This course is collaboratively sponsored by the Organization for Tropical Studies and the Amazon Center for Environmental Education and Research. It will focus on the unique characteristics of the flooded and upland forests of the western Amazon region near Iquitos, Peru. This course is primarily intended to serve Latin American graduate students, although Spanish-speaking graduate students may apply regardless of nationality. Coordinators are Drs. Bette Loiselle and Alejandro Farji. Contact: *Dr. Nora Bynum, Box 90630, Durham, NC 27708-0630; Phone: (919) 684-5774* <elb@acpud.duke.edu>.

**The Birds of Costa Rica: Tropical Bird Ecology for Birding Enthusiasts.** December 8-21, 1998; April 13-26, 1999; August 24 –September 6, 1999; Monteverde, Costa Rica, Central America. Cost: \$1900. Contact: *The Monteverde Institute, Aptdo 10165-1000, San Jose, Costa Rica;* <mvipac@sol.racsa.co.cr>.

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**JOB OPPORTUNITIES**


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**UCSB/GEOGRAPHY POSTGRADUATE RESEARCH**

The Department of Geography at the University of California, Santa Barbara, seeks a candidate with a strong background in hydrological modeling and an emphasis on GIS. The successful candidate will participate in collaborative research associated with the Wind River Canopy Crane Research Facility. The candidate will integrate remotely sensed data to support geographic layers in a distributed hydrological model and will be expected to coordinate research activities, develop publications, and present research results at professional conference. Appointment will be for at least one year. Contact: *Dr. Dar A. Roberts, Department of Geography, Ellison Hall Room 3611, University of California, Santa Barbara, CA 93106-4060; Phone:(805) 893-2276;* <dar@geog.ucsb.edu>.

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**VOLUNTEERS NEEDED FOR RESEARCH IN BORNEO**

Volunteers are needed to assist a PhD student project concerned with regeneration of logged forest. The project is testing a hypotheses about plant- herbivore interactions of seedlings growing in gaps at Danum Valley, Malaysian Borneo. Individuals are needed for two-month intervals at the end of January 1999 and/or at the beginning of June 1999. There may be some funds available for accommodation, but the volunteer is required to pay his/her own airfare. Contact: *Katharine Liston, Department of Animal and Plant Sciences, Sheffield University, Western Bank, Sheffield, S102TN, United Kingdom. Phone: 01433-631-747;* <bop96kl@sheffield.ac.uk>.

## 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 recent literature. Some of the papers listed below were obtained from ICAN subscribers sending in reprints; most were discovered by doing monthly on-line literature searches (AGRICOLA, CAB, and FORESTRY ABSTRACTS) and going through Current Contents on Diskette].

### CANOPY ANIMALS

- Dareau, M., J. Martel, J.-L. DesGranges, & Y. Mauffette. 1997. Associations between forest decline and bird and insect communities in northern hardwoods. *Canadian Journal of Forest Research* **27**:876-882.
- Mönkkönen, M., P. Reunanen, A. Nikula, J. Inkeröinen, & J. Forsman. 1997. Landscape characteristics associated with the occurrence of the flying squirrel *Pteromys volans* in old-growth forests of northern Finland. *Ecography* **20**:634-642.
- Palacios-Vargas, J. G., G. C. Meneses, & J. A. Gómez-Anaya. 1998. Collembola from the canopy of a Mexican tropical deciduous forest. *Pan-Pacific Entomologist* **74**:47-54.
- Shaw, D. 1998. Distribution of larval colonies of *Lophocampa argentata* Packard, the silver spotted tiger moth (Lepidoptera: Arctiidae), in an old growth Douglas-fir, *Pseudotsuga menziesii*/Western hemlock, *Tsuga heterophylla*, forest canopy, Cascade mountains, Washington State. *The Canadian Field-Naturalist* **112**:250-253.

### CANOPY PLANTS

- Balaguer, L., E. Manrique, & C. Ascaso. 1997. Predictability of the combined effects of sulphur dioxide and nitrate on the green-algal lichen *Ramalina farinacea*. *Canadian Journal of Botany* **75**:1836-1842.
- Doligez, A., & H. I. Joly. 1997. Mating system of *Carapa procera* (Meliaceae) in the French Guiana tropical forest. *American Journal of Botany* **84**:461-470.
- Foster, P. F., & V. L. Sork. 1997. Population and genetic structure of the West African rain forest liana *Ancistrocladus korupensis* (Ancistrocladaceae). *American Journal of Botany* **84**:1078-1091.
- Hietz, P. 1997. Population dynamics of epiphytes in a Mexican humid montane forest. *Journal of Ecology* **85**:767-775.
- Intrieri, C., S. Poni, B. Rebutti, & E. Magnanini. 1997. Effects of canopy manipulations on whole-vine photosynthesis: results from pot and field experiments. *Vitis* **36**:167-173.
- Kluge, M., B. Vinson, & H. Ziegler. 1997. Ecophysiological studies on orchids of Madagascar: incidence and plasticity of crassulacean acid metabolism in species of the genus *Angraecum* Bory. *Plant Ecology* **135**:43-57.
- Zotz, G., M. T. Tyree, S. Patiño, & M. R. Carlton. 1998. Hydraulic architecture and water use of selected species from a lower montane forest in Panama. *Trees* **12**:302-309.

## CANOPY STRUCTURE

- Aiba, S.-I., & T. Kohyama. 1997. Crown architecture and life-history traits of 14 tree species in a warm-temperate rain forest: significance of spatial heterogeneity. *Journal of Ecology* **85**:611-624.
- Cescatti, A. 1998. Effects of needle clumping in shoots and crowns on the radiative regime of a Norway spruce canopy. *Annals of Science Forestry* **55**:89-102.
- Hassinen, A., M. Lemettinen, H. Peltola, S. Kellomäki, & B. Gardiner. 1998. A prism-based system for monitoring the swaying of trees under wind loading. *Agricultural and Forest Meteorology* **90**:187-194.
- Kucharik, C.J., J.M. Norman, L.M. Murdock, and S.T. Gower. 1997. Characterizing canopy nonrandomness with a Multiband Vegetation Imager. *Journal of Geophysical Resources* **102**:29,455-29,473.
- Kucharik, C.J., J.M. Norman, and S.T. Gower. 1998a. Measurements of branch area and adjusting leaf area index indirect measurements. *Agricultural and Forestry Meteorology* **91**:69-88.
- Kucharik, C.J., J.M. Norman, and S.T. Gower. 1998b. Measurements of leaf orientation, light distribution and sunlit leaf area in a boreal aspen forest. *Agricultural and Forestry Meteorology* **91**:127-148.
- Makela, A., & P. Vanninen. 1998. Impacts of size and competition on tree form and distribution of above ground biomass in Scots pine. *Canadian Journal of Forest Research* **28**:216-227.
- Raulier, F., C.-H. Ung, & J. Begin. 1998. Analytical estimation of branchwood volume in sugar maple, linked to branchiness. *Trees* **12**:395-405.
- Sterck, F. J., & F. Bongers. 1998. Ontogenetic changes in size, allometry, and mechanical design of tropical rain forest trees. *American Journal of Botany* **85**:266-272.
- Sumida, A., & A. Komiyama. 1997. Crown spread patterns for five deciduous broad-leaved woody species: ecological significance of the retention patterns of larger branches. *Annals of Botany* **80**:759-766.
- Valinger, E., & J. Fridman. 1997. Modelling probability of snow and wind damage in Scots pine stands using tree characteristics. *Forest Ecology and Management* **97**:215-222.

### FOREST-ATMOSPHERE INTERACTIONS

- Beverland, I. J., J. M. Crowther, M. S. N. Srinivas, & M. R. Heal. 1998. The influence of meteorology and atmospheric transport patterns on the chemical composition of rainfall in south-east England. *Atmospheric Environment* **32**:1039-1048.
- Dambrine, E., B. Pollier, M. Bonneau, & N. Ignatova. 1998. Use of artificial trees to assess dry deposition in spruce stands. *Atmospheric Environment* **32**:1817-1824.
- Flanagan, L. B., & J. R. Ehleringer. 1998. Ecosystem-atmosphere CO<sub>2</sub> exchange: interpreting signals of change using stable isotope ratios. *Trees* **13**:10-14.

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Hikosaka, K., & T. Hirose. 1997. Leaf angle as a strategy for light competition: optimal and evolutionarily stable light-extinction coefficient within a leaf canopy. *Ecoscience* **4**:501-507.

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Dolman, A. J., E. J. Moors, J. A. Elbers, & W. Enijders. 1998. Evaporation and surface conductance of three temperate forests in the Netherlands. *Annales des Sciences Forestières* **55**:255-270.

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Lawton, J. 1998. Green tourism and nature's services. *Oikos* **82**:3-4.

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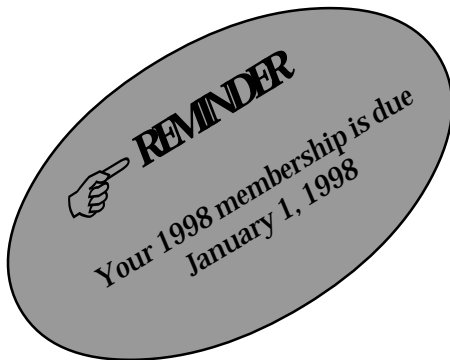
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