



WHAT'S UP?

THE NEWSLETTER OF THE INTERNATIONAL CANOPY NETWORK

NALINI NADKARNI, EDITOR

DAVID FRANKLIN, EDITORIAL ASSISTANT

Announcement of the Global Canopy Program

The emerging field of forest canopy research is rapidly moving toward a globally integrated area of inquiry. In December 1999, the European Science Foundation and National Science Foundation funded an international workshop in Oxford, U.K. The group of 30 leading canopy researchers articulated a plan for a global program of research, education, and conservation projects that link canopy investigations around the world into one integrated program. The final resolution called for “...an integrated, coordinated study of canopies across major environmental and management gradients to investigate the role of forest canopies in maintaining global biodiversity, global environmental conditions and the sustainability of forests.”

Members of the Steering Committee of the Oxford meeting have followed workshop recommendations to seek funding to facilitate comparative canopy research on these topics of deep societal concern. Following proposal submissions by Andrew Mitchell, the UK's Rufford Foundation and The Maurice Laing Foundation have awarded £200,000 (\$300,000) over two years to establish the Global Canopy Program (GCP).

The GCP will be working closely with and through the International Canopy Network (ICAN). Communication pathways established by ICAN (e-mail bulletin board, quarterly newsletter, canopy databases) will serve to disseminate information about GCP activities. A full report of the workshop is posted on the ICAN website (<http://www.evergreen.edu/ican>).

Andrew Mitchell (GCP Director) has established a Secretariat office at the Oxford Forestry Institute, University of Oxford, U.K. This office will administer activities that bring together scientists in the GCP and will co-ordinate the direct dissemination of research funds. Staff include Katherine

Secoy (GCP Co-ordinator) and Andrew Davis (consulting Research Director, based at Green College in Oxford). A website describing the scope of the GCP is being developed (<http://www.nry.co.uk/gcp>).

Another mission of the GCP is to raise funds for a series of *Pathfinder Projects*. These are research projects that will use harmonized techniques to investigate a particular question in several different forest canopy sites to generate data that can be compared across forest types and geographical locations. They will also enhance active international collaboration. Details on funding will be announced during the first quarter of 2001. A formal Request for Proposals will be disseminated through the newsletter, listserv, and website of ICAN.

The GCP Secretariat plans to formally launch the Program with a call for coordination at the forthcoming Third International Canopy Conference in Cairns, Australia in June 2002 (<http://www.premiers.qld.gov.au/whatsnew.htm>).

The organizers of the GCP recognize that the success of such a program is dependent upon this being an inclusive process. We are grateful to those who contributed ideas and enthusiasm at the Oxford workshop. Input and participation from all those interested in contributing to the objectives of an integrated canopy science program are invited. We will keep you informed of developments with the exciting new opportunities the GCP offers.

Respectfully submitted:

-Andrew Mitchell, Oxford Forestry Institute, University of Oxford,
GCP Director; <amitchell@earthwatch.org>

-Nalini M. Nadkarni, International Canopy Network, President;
<nadkarnn@evergreen.edu>

3rd INTERNATIONAL CANOPY CONFERENCE

JUNE 2002 - CAIRNS, AUSTRALIA

The Queensland Government and the Smithsonian Institution are proud to support the 3rd International Canopy Conference to be held in Cairns, north Queensland, Australia from 23-28 June, 2002. The conference theme is **Science, Policy and Utilisation**, and will bring together scientists, environmental managers and policy-makers concerned with the discovery and sustainable use of forests around the world.

Conference organisers are calling for papers on the following possible topics:

- | | |
|--|--|
| § Conservation and policy | § Canopy architecture |
| § Environment and people | § Epiphytes, vines, and lianes |
| § Economics and utilisation (e.g. ecotourism, ecosystem services, pharmaceuticals and other products from the canopy, horticulture etc.) | § Processes of water, carbon, and energy exchange in complex, multi-species canopies |
| § Environment and ecology | § Regional issues |
| § Biodiversity patterns (vertebrates and invertebrates) | § Methods and techniques of research |
| § Impacts of changing climate | § Australian perspectives and issues |
| § Gas exchange | § Indigenous people and forests |
| § Hydrology, meteorology and the physico-chemical environment | § Animal/plant interactions |
| | § Disturbance |
| | § Launch of the Global Canopy Program |

THE LIST IS NOT EXHAUSTIVE AND PROPOSALS FOR SYMPOSIA AND PAPERS ON OTHER TOPICS ARE WELCOMED

Project Managers:

Professor Nigel Stork
Rainforest CRC
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Forest Canopy Research Reports

LEAF ANATOMICAL RESPONSES TO LIGHT IN FIVE TROPICAL MORACEAE OF DIFFERENT SUCCESSIONAL STATUS

We characterized the leaf anatomical characteristics and maximum assimilation rates of five neotropical *Moraceae* of different genera and successional positions. Plants were grown under different light levels and transferred to high light which stimulated canopy openings. Total blade thickness increased with irradiance among all species, and thicker blades were developed when plants were switched. However, blade thickness, and the extent to which it was modified, was independent of the species' successional position and did not predict photosynthetic performance. Palisade thickness was a good predictor of maximum photosynthetic rate, but only on a species-specific basis. The early successional plants, *Cecropia obtusifolia* and *Ficus insipida*, exhibited similarly high photosynthetic plasticity and acclimation values, but differed in their leaf anatomical traits. The late successional canopy emergent, *Poulsenia armata*, produced the most plastic leaves, but failed to acclimate both anatomically and physiologically when transferred to higher light levels.

Strauss-Debenedetti, S. and G. P. Berlyn. 1994. American Journal of Botany. **81**:1582-1591.

A CYTOPHOTOMETRIC TECHNIQUE FOR MEASURING PHOTOSYNTHETIC POTENTIAL OF LEAVES

Quantifying the growth capabilities of trees is a goal of research in forest biology. In regions of the world where forest decline is prevalent (e.g. red spruce in the northeastern United States and Norway spruce in Europe), this quest has become even more pressing. Many theories have been proposed to explain relatively sudden declines in tree vigor, but there is a paucity of consistent, accurate growth data necessary to verify these theories. Our research is devoted to illuminating the growth potential of a tree using the concept of Total Photosynthetic Potential (TPP). As a measure of the reductive potential of all chlorophyll in a particular plant, TPP is the product of a capacity factor (such as effective and/or actual leaf area) and an intensity factor (such as the total absorbing chlorophyll mass). Because the TPP concept is independent of tree morphology, it has advantages over models requiring structural or geometric assumptions about the distribution and arrangement of chlorophyll within the tree canopy.

Berlyn, G. P., B. L. Albers, and R. Thadani. 1996. Preliminary research and development. Biotechnic and Histochemistry. **71**:251-257.

CHANGES IN LEAF STRUCTURE IN RELATION TO CROWN POSITION AND TREE SIZE OF *BETULA PAPYRIFERA* WITHIN FIRE-ORIGIN STANDS OF INTERIOR CEDAR-HEMLOCK.

Dimensions of anatomical and morphological attributes are key structural measures that can influence physiological response to changes in environment. Linking structural attributes of leaves to physiological measures in relation to the life history and crown position of a tree species can provide a clearer understanding of species growth in relation to successional development. This study examined foliar anatomy, morphology and physiology of *Betula papyrifera* Marsh trees growing in three stages of stand development of interior cedar-hemlock forest, northern British Columbia. Physiological, morphological and anatomical measurements of leaves located at six different positions within the crown were made on trees selected from stands that originated 15, 55, and 145 years after catastrophic fire. Maximum net photosynthesis, stomatal conductivity, leaf area and mass, and relative chlorophyll content were measured in the field. Microscopic measures were made of the thickness of leaf, cuticle, upper epidermis, palisade and spongy mesophyll and lower epidermis. Stomatal density and aperture length were also determined.

Foliar anatomy, morphology, and physiology varied significantly with both position in the crown and age of tree. The changes in leaf anatomy, morphology, and physiology observed across the forest chronosequence are strongly related to canopy position, which probably reflects changing availability of light and soil moisture experienced throughout the tree during crown development. Foliage of 145-year-old trees exhibit attributes characteristic of the sun-shade dichotomy. However, foliage of young saplings exhibited a pattern of unrestrained growth, while foliage of trees in the stem exclusion stage suggested a strong transitional period of intense competition.

Information from this study has clarified the mechanistic understanding of forest succession by depicting how underlying foliar structure and physiology responds to surrounding environment and drives growth and survival of individual trees.

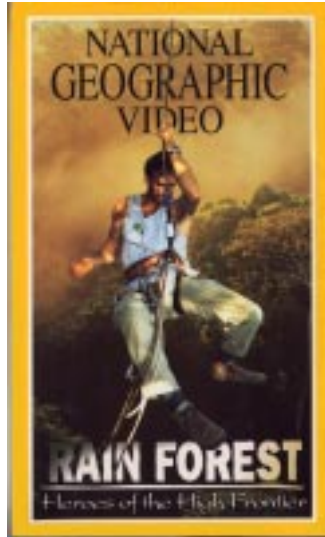
Ashton, P. M. S., L. Olander, R. Thadani, G. P. Berlyn, and I. R. Cameron. 1998. Canadian Journal of Botany **76**: 1180-1187.

Higher and Higher: Canopy Documentary Wins Top Award

The National Geographic Special/NBC documentary, "Exploring the High Frontier" (also known as the National Geographic Home Video "Rainforest: Heroes of the High Frontier"), documents the work of canopy scientists around the world and portrays wildlife highlights of the canopy. The film recently won an Emmy Award in the Best Documentary category for "Outstanding Informational or Cultural Programming" by the Academy of Television, Arts and Sciences.

The film was also nominated for three "craft" awards, including "Outstanding Individual Achievement in a Craft in News and Documentary Programming for Cinematography, Editing and Music." The award recipients were chosen by a blue-ribbon panel of peers from more than 1500 entries during the eligibility period of 1999.

Producer/director Tim Scoones and co-producer/writer Cathy McConnell received the award at a black-



tie dinner at the Marriot Marquis Hotel on Broadway, New York City on September 6th, 2000. In his acceptance speech, Mr. Scoones thanked the film team who worked hard to craft this ground-breaking film, and also dedicated the award to "the real heroes of the piece-the incredible canopy scientists who have made it their life's work to uncover the secrets of the canopy. This is their film and their story," he said. "As documentary-makers, we are merely voyeurs. Without the amazing work of these incredible people we would have no film and we wouldn't be receiving this award tonight. So I take this award in their honor."

For more information, contact:

Tim Scoones; British Broadcasting Corporation, Broadcasting House Whiteladies Rd., Bristol, BS8 2LR, UNITED KINGDOM; Phone: +44 117 9243871; <timscoones@compuserve.com>.

To purchase the video, visit <<www.nationalgeographic.com>>, click on "Store", then type "heroes" in the search field.

Fun Tree Biology Site Launches for Kids and Teachers

Every kid and teacher interested in trees, tree biology and the importance of trees to our environment is invited to visit <<<http://www.gfawesome.org>>> - a fun, free, and educational website that was launched in October by the non-profit science foundation Global Forest.

All "Gfawesome Club" members receive stickers of mascots Maurice the Mountain Goat and Lisa the Lynx, who guide site users through fun science, gruesome factoids, and cool articles about tree biology. Onsite, school-aged kids from three continents contribute real-time weather data from weather stations donated by Global Forest (<http://www.globalforestscience.org>), a non-profit organization based in Vancouver, Canada.

"If kids are interested in forest science, then we can feel confident that forest conservation will have a strong future," says tree biologist Dr. Reese Halter, who founded Global Forest. "Gfawesome.org is designed to appeal to youngsters, teach

them basic forest science in a fun way, and get them talking to others committed to forest conservation."

Teachers can download engaging lesson plans about trees and their effects on water, air quality, and animals. Teachers, kids, and parents are encouraged to join the GFAwesome club to receive a membership certificate, free stickers, newsletters, and other prizes for participating in ecological activities.

For information, contact: Dr. Reese Halter
E-mail: <rhalter@globalforestscience.org>
Phone: (604) 733-2503 or (866) 977-7377



Bangalore or Bust: Annual Meeting of the Association for Tropical Biology

The Association for Tropical Biology (ATB) will hold its annual meeting for the year 2001 from July 15-18 in Bangalore, India. The ATB has built its reputation on the publication of a high quality, widely cited journal, *Biotropica*, and on the sponsorship of international symposia on diverse tropical issues (<http://www.atb.botany.ufl.edu>, www.atb.botany.ufl.edu).

This meeting is being hosted and sponsored by the Ashoka Trust for Research in Ecology and the Environment (ATREE).

ATREE (<http://www.atree.org>) is a non-profit organization based in Bangalore, and its mission is to advance protection of the environment, conserve biodiversity and promote sustainable use of resources. The meeting will be co-hosted by leading national scientific institutions and organizations including the Indian Academy of Sciences, Bangalore, IUSSI-Indian Chapter, Bangalore, University of Agricultural Sciences, Bangalore and the Indian National Science Academy, New Delhi.

The theme of the symposium is Tropical Ecosystems: Structure, Diversity and Human Welfare. The three-day meeting will consist of symposia, round-table discussions, contributed paper sessions, keynote talks and poster presentations. The meeting will address three major theme areas:

- a) Global change and tropical forest ecosystems,
- b) Tropical forests: structure, diversity and function, and
- c) Biodiversity hot-spots.

One of the foci of the meeting will be on tropical forest canopies. Nalini Nadkarni and Steve Yanoviak (The Evergreen State College) will be co-organizing a symposium, "Tropical Forest Canopy Ecology", during the meeting, with scientific papers from six international scientists. Topics include aspects of canopy invertebrate ecology in Gabon and in Costa Rica, bromeliad conservation in South America, canopy fungi in South and Central America, and canopy tree pollination in the Western Ghats of India. A discussion on the coordination of tropical canopy research will follow the formal talks.



By bringing together researchers from all over the world, we will foster exchange of ideas and information, set agendas for the future, and explore opportunities for collaborative work.

Contact: Dr. K. N. Ganeshiah, Chair, IOC; Dr. Kamal S. Bawa, President, ATB, Member IOC; International Conference on Tropical Ecosystems Structure, Diversity and Human Welfare or Secretariat; ATB 2001, c/o ATREE, No 659 5th A Main, Hebbal, Bangalore 560 024, India; Phone: 91 80 353 3942; Fax: 91 80 353 0070; <atb2001@vsnl.com>; Website: <<http://www.atb2001.org>>.

ADVISORY BOARD BIO-SKETCH

Eric Bolen earned a B.S. degree in Wildlife Management, with a forestry minor, from the University of Maine (1959) and M.S. (1962) and Ph.D. (1967) degrees in Wildlife Ecology from Utah State University. Both universities subsequently recognized him with alumnus awards. He served as Dean of the Graduate School at the University of North Carolina at Wilmington (1988-94), where he now teaches in the Department of Biological Sciences. Previously, he was the Paul Whitfield Horn Professor of Wildlife Ecology and Associate Dean of the Graduate School at Texas Tech University (1978-88), and Assistant Director of the Welder Wildlife Foundation (1973-78).

Dr. Bolen is listed in *National Leaders of American Conservation* and previously served on an advisory board for the Assistant Secretary of the Interior for Parks and Wildlife. He has been a member of The Wildlife Society since 1959; he is also a member of the Wilson Ornithological Society, Cooper Ornithological Society, Association of Field Ornithologists, American Society of Mammalogists, Society for Range Management, Forest History Society, and an elected member of the American Ornithologists' Union. He previously served as editor of the *Wildlife Society Bulletin* and on the editorial boards of *Conservation Biology* and *Landscape and Urban Planning*.



Dr. Bolen has published about 180 papers in professional media, 20 articles in *World Book Encyclopedia*, and contributes the conservation section to *Science Year*, also published by *World Book*. His books include: *Wildlife Ecology and Management*, *Mississippi Kite: Portrait of a Southern Hawk*, *Wildlife and Habitats in Managed Landscapes*, *Waterfowl Ecology and Management*, and, most recently, *Ecology of North America*.

LIFE IN THE TREETOPS AT GREAT SMOKY MOUNTAINS NATIONAL PARK

INTRODUCTION

Research objectives established for this project on tree canopy biodiversity include:

- to carry out the first comprehensive survey and inventory of tree canopy cryptogams;
- to assemble a multidisciplinary, international research team to serve as experts who will collect, identify, and curate this diverse group of organisms;
- to search for undescribed taxa new to science in all of the targeted groups of organisms;
- to involve undergraduate and graduate students in an exciting research project at a Research in Undergraduate Institution (RUI) that will result in a continued professional interest in the study of the targeted groups of organisms.

THE RESEARCH SITE

The Great Smoky Mountains National Park (GSMNP) is famous for its large tracts of old-growth forest, comprising over 40,000 ha in the eastern United States. The Smokies are home to five forest types: spruce-fir, northern hardwood, pine-oak, hemlock, and cove hardwood. These forests are also home to over 130 species of trees and over 4000 plant species. Some of the old-growth forest habitats are complex, which can mean higher species diversity for a wide spectrum of life forms. The climate is suited for the growth of fungi, bryophytes, and lichens because of the maritime tropical air bringing year-round moisture. Species richness is reflected in the classification of the GSMNP as an International Biosphere Reserve. Even though the park has over 10 million visitors each year, over 75% of its 813 square miles is preserved as wilderness.



A new research initiative under the rubric of the All Taxa Biodiversity Inventory (ATBI) program will attempt to inventory and identify all of the life forms in the GSMNP. Through identification of species and mapping of their ranges, a synopsis of each taxon's natural history and ecological role will help to understand the significance of the park's biodiversity and provide baseline data needed to measure change over time.

NATIONAL SCIENCE FOUNDATION GRANT

The National Science Foundation Biotic Surveys and Inventories program provided funds to support the research project, called "Tree Canopy Biodiversity (myxomycetes, macrofungi, mosses, liverworts, and lichens) in the Great Smoky Mountains National Park." This was supported by a grant program called the Small Grant Exploratory Research program. Undergraduate student research projects were funded by a separate supplemental grant entitled Research Experiences for Undergraduates (REU). Student research projects compared biodiversity associated with the tree canopy to biodiversity on ground sites for the targeted groups of organisms. Isolation and identification of tardigrades, referred to as water bears, will also be an REU

sponsored project. More detailed information and photographic images about the student research projects, climbing activities, and specimens collected are at <http://www.cmsu.edu/biology/bio/index.htm>.

MULTIDISCIPLINARY RESEARCH TEAM

The multidisciplinary research team served as mentors for the students and gave lectures, slide shows, and field dem-

onstrations during evenings on the targeted groups of organisms to aid the student climbers in the recognition and collection of specimens. Team members included Harold W. Keller, Central Missouri State University, Principal Investigator (myxomycetes); Uno Eliasson, Co-PI, Göteborg University, Sweden, ecologist; Alex Ciegler, Columbia, South Carolina, lichenologist; Paul Davison, University of North Alabama, bryologist; Thomas Gaither, Slippery Rock University, mycologist; Ken Nelson, ecologist; Jay Raveill, Central Missouri State University, plant systematist and expert on the flora of the GSMNP; David K. Smith, University of Tennessee, bryologist; and Ted Stampfer, moist chamber culture specialist.

DOUBLE ROPE CLIMBING TECHNIQUE IN SAMPLING THE TREE CANOPY

The versatility, mobility, and cost efficiency of the double rope technique made it the most suitable for this project. This climbing technique allowed for rope advancement once the climber was situated on a branch in the tree canopy. Equipment is minimal and each climber can pack all of his/her gear in a standard backpack. Students successfully climbed 160 trees representing over 20 tree species. No student was injured while climbing trees.

Choice of trees was a crucial first step. Trees were inspected for poison ivy, a sound healthy trunk, and any dead or decaying branches. Once a suitable tree was selected to climb, a throw bag attached to a "slick line" was tossed or shot with a "BIGSHOT" sling-shot over the highest, sturdiest, and most accessible branch. Samples were taken at intervals as the tree was ascended. Students were able to quickly master the double rope climbing technique, making it possible to gather samples over 300 m high in the treetops. Anchoring the rope high enough enabled the climber to safely walk out onto long horizontal branches and sample areas away from the trunk. A return trip to the GSMNP is planned next summer.



PERSONAL OBSERVATIONS OF A TREE CLIMBER

An environmental change occurred on most trees between 10-20 m. Fewer mosses and mushrooms were found at higher elevations, but even more surprising was the presence of myxomycete plasmodial tracks and sporangia. Spectacular, golden iridescent sporangia of a myxomycete on a white oak tree were discovered, which were believed by Dr. Harold W. Keller to be a new species of *Diachea*. This taxon appears to be restricted to the tree canopy. At the top of a tree, 30-40 m high, the canopy is festooned with lichens, apparently because more light is available at these lofty heights.

The branching pattern of each tree varied greatly. Bark texture also varied on different tree species, making it either impossible to sample, even with a razor-sharp knife, or flaking so easily that a butterknife could strip the entire tree. The older bark near the base of the tree was easy to sample, but the bark near the top frequently adhered so tightly that it was almost impossible to remove.

The professionalism of our tree climbing crew made this field experience a safe and productive time we will never forget.

ACKNOWLEDGMENTS

This article was prepared by Laura Henley, Melissa Skrabal, Kenny Snell, and James 'Buck' Counts, all students at Central Missouri State University. We thank our tree climbing instructor, Charly Pottorff, from Manhattan, Kansas; Mike Ferro, a fellow student at Central Missouri State University, our web page designer; and Jim Murray from Arlington, Texas, our project photographer.

For more information, contact: Dr. Harold Keller, Office of Graduate Studies, Central Missouri State University, 410 Humphreys, Warrensburg, MO 64093; Phone: (660) 543-4327; Fax: (660) 543-8333; E-mail: <keller@cmsu1.cmsu.edu>.

ANNOUNCEMENTS

The Polish Journal of Ecology publishes scientific papers dealing with all aspects of fundamental and applied ecology, including physiological ecology, ecology of population, community, ecosystems, and landscapes, as well as global ecology. All types of papers are reviewed. All papers are published in English. Contact: *Prof. Dr. Anna Hillbricht-Ilkowska, Managing Editor, Polish Journal of Ecology (Ekologia Polska), Dziekanow Lesny near Warsaw, 05-092 Lomianki, Poland; Fax: (48 22) 751 31 00; <ekolog@warman.com.pl>*.

Benefits of Biodiversity. The Council for Agricultural Science and Technology, an international consortium of 36 scientific and professional societies, has released a major policy report on biological diversity entitled "Benefits of Biodiversity". The report details recommendations on the importance of conservation of biodiversity and its links to maintaining agricultural productivity. Contact: *CAST, 4430 West Lincoln Way, Ames, Iowa, 50010, USA*.

Ecosystem Management of Forest Landscapes: Directions and Implementations. A collection of 26 papers has been published in paperback by the University of British Columbia Press, ISBN: 096865410X. Contact: *Marlo Miller, Kokanee Forests Consulting, 201-625 Front Street, Nelson, BC V1L 4B6; Phone: 250-352-9141; Fax: 250-352-1842; <marlo@kgis.com>; << http://www.ubcpress.ubc.ca/>>*.

Global Warming. A new analysis of the climate of the last 1000 years suggests that human activity is the dominant force behind the sharp global warming trend seen in the 20th century. The study is by Dr. Thomas J. Crowley, a geologist at Texas A&M University. Visit: <<<http://www.nytimes.com/library/national/science/071400sci-enviro-climate.html>>>.

Crown Balloons:

This site contains information on a new transport system that uses 14 large helium balloons for travel over difficult terrain while attached to treetops and/or sea anchors. The system permits access and long term residence (16 people for 6 months) over jungle canopies. The site features newly added photos of the system from a 1/20 scale model. Fabrication of the system will possibly begin before the end of next year, and a "site cam" is in the works for people to watch the progress of the project. Contact: *Frank Hodgson; <akilo55@yahoo.com>; <<http://www.akilo.com>>*.

The CIDA Forestry Advisers Network (CFAN):

CFAN has recently posted a new presentation on its website called "Tropical Forests and Climate Change". <<<http://www.rcfa-cfan.org/english/issues.13.html>>>

USDA Forest Service 2000 Strategic Plan:

The draft 2000 revision of the USDA Forest Service Strategic Plan has recently been made available on this website. The revision addresses the issue of sustainable forest management much more so than the previous forms of the plan. Its four goals focus on ecosystem health, multiple benefits for people, scientific and technical assistance, and effective public service. Users can retrieve the full plan online and submit comments on each section. <<<http://www.fs.fed.us/plan/>>>

Species Diversity and Richness II:

This is a program to aid ecologists and environmentalists in the calculation and application of diversity indices and in estimating total species richness for a habitat. The program is available for Windows 95/98. The new release includes: diversity measures, beta diversity, data simulation from a variety of models, distribution fitting, and between-sample comparisons of diversity using randomization tests. <<<http://www.irc-house.demon.co.uk>>>

WEBSITES

NatureServe:

This new "online encyclopedia of life", developed by the Association for Biodiversity Information (ABI), is now available to the public on the Internet. NatureServe provides authoritative conservation information in a searchable database for more than 50,000 plants, animals, and ecological communities of the United States and Canada. The site provides in-depth information on rare and endangered species, the leading source for ecological communities, and colorful distribution maps. Visit NatureServe:

<<<http://www.natureserve.org>>>

The Biodiversity Support Program (BSP):

BSP has a new website that highlights results and insights gained from BSP's over 12 years of research to understand the conditions required for biodiversity conservation to be achieved. This website presents overviews of BSP's regional and cross-cutting programs, and an electronic library of BSP publications. <<<http://www.BSPonline.org>>>

Plant Image Gallery:

Created and maintained by Thomas Schoepke of the Institute of Pharmacy at Greifswald University, this site is useful to both botanists and biology students. Behind the straightforward interface is a database of some 2000 high-

quality images of plants, mainly from Europe, Costa Rica, Japan, and the Galapagos Islands. Users can browse the images by four geographic galleries or by plant family. Entries include the Latin name, whether the plant is native or cultivated, and photo location. <<<http://www.plant-pictures.com/>>>.

From The Scout Report, Copyright Internet Scout Project 1994-2000. <<<http://scout.cs.wisc.edu>>>.

Database of Plant Databases (DPD):

This website, hosted by the International Organization for Plant Information (IOPI), a Commission of the International Union of Biological Sciences (IUBS), is a global list of plant databases with hundreds of links. This includes taxonomic databases, collection catalogs, and DELTA datasets. The DPD may be searched using numerous specified fields, or viewed in its entirety by database name, host name, or host country. <<<http://iopi.csu.edu.au/iopi/iopidpd1.html>>>.

Pacific Institute for Studies in Development, Environment, and Security: An updated version of our searchable online bibliography of peer-reviewed and gray literature on the impacts of climate change on flora and fauna species and supporting ecosystems is now available on our site at <<<http://www.pacinst.org/wildlife.html>>>. Over 250 citations have been added in the past two months and the bibliography now contains more than 2100 citations. Suggestions for additions or corrections to the bibliography are greatly appreciated.

PUBLICATIONS OF INTEREST

Diversity and Ecology of the Vascular Epiphytes in a Montane and a Lowland Rain Forest in Venezuela

Stefan Engwald. 1999. ISBN: 3-89811-184-9. (German)

This book presents an extensive analysis of the ecology and biodiversity of epiphytes in tropical rainforests. It contributes to the question of how rainforest canopies allow for the highest species diversity on earth by focusing on the epiphytic plants of an Andean mountain and of an Amazonian lowland forest (Surumoni crane project) in Venezuela. Data was taken for more than 6000 individual plants with substrate analyses, and photosynthesis was investigated. This book contains information on the biodiversity, floristics, morphology, reproduction biology, dynamics, and physiology of epiphytes, forest and habitat structure, and microclimate. A summary of the results is provided in English and Spanish. Contact: *Libri-Books on Demand, Hamburg, Germany*, <<<http://www.libride.de>>>; <<service@libride.de>> OR Dr. Stefan Engwald, *Exam. Biologie und Gartenbauwissenschaftler, Botanisches Institut der Universität Bonn, Abt. für Systematik und Biodiversität, Meckenheimer Allee 170, G-53115 Bonn*, Phone: 0049-228-73 22 68; Fax: 0049-228-73 31 20; <<engwald@uni-bonn.de>>.

Dynamics of Tropical Communities

D.M. Newbery, H.T. Prins, & N.D. Brown (eds.). 1998. ISBN: 0632049448.

The first part of the book discusses the phenology and life history of seeds and fruits of tropical rainforest plants. It considers the effects of disturbances, architecture, and development in rainforest trees, community structure, and limits to tree species distributions in lowland tropical rainforests. The second part explores the phenology and dynamics of an African rainforest, describing present, past, and future patterns in the Lope Reserve, Gabon and the effects of habitat fragmentation, disturbance and succession, human disturbances, spatial patterns of tropical forests and change with time, as assessed by remote sensing. Contact: *Blackwell Science Ltd, Osney Mead, Oxford OX2 0NE, UK*; Phone: +44 1865 206206; Fax: +44 1865 721205; <<sara.willis@blacksci.co.uk>>; <<<http://www.blacksci.co.uk>>>.

Temperate and Boreal Forest Resource Assessment (TBFRA)

Published jointly by the UN Economic Commission for Europe (ECE) and the UN Food and Agriculture Organization (FAO), this new 445-page report has been described as "the most comprehensive set of internationally comparable data on the temperate and boreal forests ever issued." This report "expands to provide information on practically all aspects of the forest." Its findings include some good news, namely that temperate and boreal forests in nearly 55 countries are expanding, including those in Europe, where timberland is increasing by 500,000 ha/yr, while only 60% of the growth is harvested annually. The full text of the report may be downloaded by chapter in .pdf format. Visit:

<<<http://www.unece.org/trade/timber/fra/welcome.htm>>>.

From the Scout Report, Copyright Internet Scout Project 1994-2000. <<<http://scout.cs.wisc.edu>>>.

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 March, 2001. 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 (.jpg format preferred). The deadline for submissions is February 15, 2001. For further information, please contact the ICAN office:

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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 STRUCTURE

- Fuller, D. O. 1999. Canopy phenology of some mopane and miombo woodlands in eastern Zambia. *Global Ecology and Biogeography* 8:199-209.
- Herwitz, S. R., R. E. Slye, and S. M. Turton. 2000. Long-term survivorship and crown area dynamics of tropical rain forest canopy trees. *Ecology* 81:585-597.
- Sala, A., S. Sabat , C. Gracia, and J. D. Tenhunen. 1994. Canopy structure within a *Quercus ilex* forested watershed: variations due to location, phenological development, and water availability. *Trees* 8:254-261.
- Sillett, S. C., and R. Van Pelt. 2000. A redwood tree whose crown is a forest canopy. *Northwest Science* 74:34-44.
- Turner, D. P., S. A. Acker, J. E. Means, and S. L. Garman. 2000. Assessing alternative allometric algorithms for estimating leaf area of Douglas-fir trees and stands. *Forest Ecology and Management* 126:61-76.

ECOSYSTEM PROCESSES

- Anthoni, P. M., B. E. Law, and M. Unsworth, H. 1999. Carbon and water vapor exchange of an open-canopied ponderosa pine ecosystem. *Agricultural and Forest Meteorology* 95:151-168.
- Goldstein, A. H., N. E. Hultman, J. M. Fracheboud, M. R. Bauer, J. A. Panek, M. Xu, Y. Qi, A. B. Guenther, and W. Baugh. 2000. Effects of climate variability on the carbon dioxide, water, and sensible heat fluxes above a ponderosa pine plantation in the Sierra Nevada (CA). *Agricultural and Forest Meteorology* 101:113-129.
- Wilson, K. B., and D. D. Baldocchi. 2000. Seasonal and interannual variability of energy fluxes over a broadleaved temperate deciduous forest in North America. *Agricultural and Forest Meteorology* 100:1-18.
- Xiao, Q., E. G. McPherson, S. L. Ustin, M. E. Grismer, and J. R. Simpson. 2000. Winter rainfall interception by two mature open-grown trees in Davis, California. *Hydrological Processes* 14:763-784.

FOREST MANAGEMENT

- Niinemets,  ., J. D. Tenhunen, P. C. Harley, and R. Steinbrecher. 1999. A model of isoprene emission based on energetic requirements for isoprene synthesis and leaf photosynthetic properties for *Liquidambar* and *Quercus*. *Plant Cell and Environment* 22:1319-1335.

FOREST-ATMOSPHERE INTERACTIONS

- Reich, P. B., D. S. Ellsworth, B. D. Kloeppel, J. H. Fownes, and S. T. Gower. 1990. Vertical variation in canopy structure and CO₂ exchange of oak-maple forests: influence of ozone, nitrogen, and other factors on simulated canopy carbon gain. *Tree Physiology* 7:329-345.
- Reich, P. B., B. D. Kloeppel, D. S. Ellsworth, and M. B. Walters. 1995. Different photosynthesis-nitrogen relations in deciduous hardwood and evergreen coniferous tree species. *Oecologia* 104:24-30.

FOREST STRUCTURE

- Zeller, Karl. 1999. Wintertime ozone fluxes and profiles above a subalpine spruce-fir forest. *Journal of Applied Meteorology* 39:92-101.
- Zeller, K. F., and N. T. Nikolov. 2000. Quantifying simultaneous fluxes of ozone, carbon dioxide and water vapor above a subalpine forest ecosystem. *Environmental Pollution* 107:1-20.

HYDROLOGY

- Meinzer, F. C., J. L. Andrade, G. Goldstein, N. M. Holbrook, J. Cavelier, and S. J. Wright. 1999. Partitioning of soil water among canopy trees in a seasonally dry tropical forest. *Oecologia* 121:293-301.

INVERTEBRATES

- Yanoviak, S. P., and M. Kaspari. 2000. Community structure and the habitat templet: ants in the tropical forest canopy and litter. *Oikos* 89:259-266.

LIGHT TRANSMISSION

- Niinemets,  ., O. Kull, and J. D. Tenhunen. 1999. Variability in leaf morphology and chemical composition as a function of canopy light environment in coexisting deciduous trees. *International Journal of Plant Science* 160:837-848.
- Roujean, Jean-Louis. 1999. Measurements of PAR transmittance within boreal forest stands during BOREAS. *Agricultural and Forest Meteorology* 93:1-6.

MICROMETEOROLOGY

- Fuentes, J. D., and D. Wang. 1999. On the seasonality of isoprene emissions from a mixed temperate forest. *Ecological Applications* 9:1118-1131.
- Hurtalov, T., and F. Matejka. 1999. Surface characteristics and energy fluxes above different plant canopies. *Agricultural and Forest Meteorology* 98-99:491-500.
- Iritz, Z., A. Lindroth, M. Heikinheimo, A. Grelle, and E. Kellner. 1999. Test of a modified Shuttleworth-Wallace estimate of boreal forest evaporation. *Agricultural and Forest Meteorology* 98-99:605-619.
- Lundin, L.-C., S. Halldin, A. Lindroth, E. Cienciala, A. Grelle, P. Hjelm, E. Kellner, A. Lundberg, M. Molder, A.-S. Moren, T. Nord, J. Seibert, and M. Stahl. 1999. Continuous long-term measurements of soil-plant-atmosphere variables at a forest site. *Agricultural and Forest Meteorology* 98-99:53-73.
- Nakai, Y., T. Sakamoto, T. Terajima, K. Kitamura, and T. Shirai. 1999. The effect of canopy-snow on the energy balance above a coniferous forest. *Hydrological Processes* 13:2371-2382.
- Rinne, J., H. Hakola, T. Laurila, and  . Rannik. 2000. Canopy scale monoterpene emissions of *Pinus sylvestris* dominated forests. *Atmospheric Environment* 34:1099-1107.

MODELING

- Martens, S. N., D. D. Breshears, and C. W. Meyer. 2000. Spatial distributions of understory light along the grassland/forest continuum: effects of cover, height, and spatial pattern of tree canopies. *Ecological Modelling* 126:79-93.
- Roderick, M. L., S. L. Berry, I. R. Noble, and G. D. Farquhar. 1999. A theoretical approach to linking the composition and morphology with the function of leaves. *Functional Ecology* 13:683-695.

NUTRIENT CYCLING

- Bravo, H. A., M. I. R. Saavedra, P. A. Sánchez, R. J. Torres, and L. M. M. Granada. 2000. Chemical composition of precipitation in a Mexican Maya region. *Atmospheric Environment* 34:1197-1204.
- Kirschbaum, M. U. F. 1999. CenW, a forest growth model with linked carbon, energy, nutrient and water cycles. *Ecological Modelling* 118:17-59.
- Loppi, S., S. A. Pirintzos, and V. de Dominicis. 1999. Soil contribution to the elemental composition of epiphytic lichens (Tuscany, central Italy). *Environmental Monitoring and Assessment* 58:121-131.
- Robertson, S. M. C., M. Hornung, and V. H. Kennedy. 2000. Water chemistry of throughfall and soil water under four tree species at Gisburn, northwest England, before and after felling. *Forest Ecology and Management* 129:101-117.

PLANTS

- Appelgren, L., and N. Cronberg. 1999. Genetic and morphological variation in the rare epiphytic moss *Necera pennata* Hedw. *Journal of Bryology* 21:97-107.
- Clement, J. P., and D. C. Shaw. 1999. Crown structure and the distribution of epiphyte functional group biomass in old-growth *Pseudotsuga menziesii* trees. *Ecoscience* 6:243-254.
- Lowman, M., L. Downey, A. Farres, and E. Mermin. 1999. Abundance and mortality of two epiphytic *Tillandsias* (Bromeliaceae) in Florida hammock. *Journal of the Bromeliad Society* 49:25-28.
- Nadkarni, N. M. 2000. Colonization of stripped branch surfaces by epiphytes in a lower montane cloud forest, Monteverde, Costa Rica. *Biotropica* 32:358-363.
- Stottlemeyer, R., and C. A. Troendle. 1999. Effect of subalpine canopy removal on snowpack, soil solution, and nutrient export, Fraser Experimental Forest CO. *Hydrological Processes* 13:2287-2299.
- Zotz, G., and V. Thomas. 1999. How much water is in the tank? Model calculations for two epiphytic bromeliads. *Annals of Botany* 83:183-192.

PLANT PHYSIOLOGY

- Kloeppel, B. D., M. E. Kubiske, and M. D. Abrams. 1994. Seasonal tissue water relations of four successional Pennsylvania barrens species in open and understory environments. *International Journal of Plant Science* 155:73-79.

REMOTE SENSING

- Nilson, T., J. Anniste, M. Lang, and J. Praks. 1999. Determination of needle area indices of coniferous forest canopies in the NOPEX region by ground-based optical measurements and satellite images. *Agricultural and Forest Meteorology* 98-99:449-462.

RESEARCH EQUIPMENT AND METHODOLOGY

- Kloeppel, B. D., and S. T. Gower. 1995. Construction and installation of acrylic minirhizotron tubes in forest ecosystems. *Soil Science Society of America. Journal* 59:241-243.
- Williams, M. S., K. L. Cormier, R. G. Briggs, and D. L. Martinez. 1999. Evaluation of the Barr & Stroud FP15 and Criterion 400 laser dendrometer for measuring upper stem diameters and heights. *Forest Science* 45:53-61.

TREE ARCHITECTURE

- Borkowski, W. 1999. Fractal dimension based features are useful descriptors of leaf complexity and shape. *Canadian Journal of Forest Research* 29:1301-1310.

VERTEBRATES

- Kalcounis, M. C., K. A. Hobson, R. M. Brigham, and K. R. Hecker. 1999. Bat activity in the boreal forest: importance of stand type and vertical strata. *Journal of Mammology* 80:673-611.
- North, M. P., J. F. Franklin, A. B. Carey, E. D. Forsman, and T. Hamer. 1999. Forest stand structure of the northern spotted owl's foraging habitat. *Forest Science* 45:520-527.
- Reunanen, P., M. Mönkkönen, and A. Nikula. 2000. Managing boreal forest landscapes for flying squirrels. *Conservation Biology* 14:218-226.

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