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ICAN

WHAT'S UP?

The Newsletter of the International Canopy Network

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SPECIAL EDITION ON THE FOREST CANOPY RESEARCH PLANNING WORKSHOP

UPWARD AND ONWARD: FOREST CANOPY RESEARCH PLANNING WORKSHOP

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EXECUTIVE SUMMARY

1. Case for a Global Canopy Research Program

The canopy is where "life meets the atmosphere". It is where urgently needed research that is directly related to two of the most pressing environmental challenges facing society - global warming and biodiversity loss - can be carried out. Forest loss is shortening the opportunity for vital basic and applied research in this area. Such research is required of governments who are signatories to major Conventions on these issues. The global canopy research program we initiated should be pursued at a significantly higher level than is currently funded, possibly on the scale of genetic and physical science projects such as the Human Genome Project and the Hubble space telescope. The need for specialized instrumentation and facilities requires and could attract major funding. Participants developed a matrix that identifies existing major canopy access points and the current state of knowledge, and concluded that additional facilities (or substantial enhancement of existing sites) are required to provide minimum coverage of the world's major forest canopy types.

2. Current Status of Canopy Research

The emergent field of forest canopy research has the capacity to address critical questions of great importance to humanity, especially those relating to global environmental change and loss of biodiversity. Although canopy studies have largely overcome technical problems of access to the treetops, until very recently, communication among research groups has been poor, with little international co-ordination of research directions or used of harmonized methods. Field sites with substantial data and canopy access systems (e.g., cranes) now exist in at least nine locations globally, and more are planned. This meeting identified common research interests and possible joint research efforts involving harmonized, comparative methods. Representatives of developing nations must be increasingly included in future planning and implementation of research and its dissemination.

3. Purpose of Meeting

· Initiate planning for a global integrated forest canopy research program;
· Articulate its central research vision and goals, and determine resources needed;
· Forge US - EU and other international partnerships in research, outreach, training, and conservation to initiate the program.

4. New Research Questions

Participants recognized that to address major questions and to attract sufficient funds to answer these questions, future canopy research must be intellectually stimulating, scientifically sound, and have relevance to human society. We generated key research questions and hypotheses applicable to a global program of research that focused on: 1) biodiversity; 2) global processes; 3) theory and integration; 4) structure function; and 5) socioeconomic implications. A large-scale question to serve as a framework for a global study was proposed: "How does the structural and biological complexity of forest canopies affect ecosystem function, persistence, and resilience?"

5. Future Needs

·***Database:*** A repository and exchange mechanism among researchers existing and future databases.
·***Communication pathways:*** Enhancement and "internationalization" of the existing largely US-based and volunteer-run International Canopy Network (ICAN) with establishment of regional and national liasons.
·***Secretariat:*** A small group (3-4) of individuals to pursue funding and coordinate global programs.
·***Improved Infrastructure:*** Development of 8-10 new field research sites (or enhancement of existing sites) in temperate and tropical forest areas using cranes and other canopy access methods.
·***Pathfinder Projects:*** Initiation of comparative studies of canopies using harmonized methods that can be implemented globally.
·***Training Programs:*** Courses and workshops to speed knowledge transfer and local capacity-building, located in both tropical and temperate countries.
·***Outreach Materials:*** Concept papers and information for distribution to potential funders, educators, policy-makers, and conservationists.
·***Planning Grant:*** A proposal to plan for and seek funds for a major global canopy research program.
·***Commitment to an International Scope and Participation:*** Efforts to enhance the involvement of participants from all nations, particularly those in developing countries.

6. Fund-raising Approaches

The goals of the global canopy research program are congruent with several potential funding sources. Links should be maintained with the European Science Foundation (ESF) and the National Science Foundation (NSF), and initiated with other international bodies (e.g., the International Union of Forest Research Organization, the European Tropical Forest Research Network, The Ecological Society of America). A proposal for an initial planning grant (US$300-500K) to cover costs of a Secretariat to pursue funding for a global program will be developed by the workshop co-convenors.

7. Schedule of Implementation

· Mar 2000 - Disseminate workshop report
· Apr 2000 - Planning Grant proposal
· Jan 2001- Article in *Science* or *Nature*
· Jul 2001 - Main Proposal
· Nov 2001 - Announcement of Global Canopy Program in Cairns, Australia.

8. Allocation of Tasks

The workshop organizers agreed to co-ordinate the Planning Grant proposal. Dr N. Stork's group and ICAN is organizing the Cairns Conference. All participants' names were added to the ICAN database and they agreed to act as representatives in their own countries. It was emphasized that future meetings and actions must be made accessible to participants from other countries, particularly developing countries.

9. Acknowledgments

Participants numbering 29, mainly from the EU and USA, were funded by grants from ESF Tropical Canopy Research program and the NSF International Programs Office (INT 9981531).

[Editor's Note: This is the final report for a Forest Canopy Research Planning Workshop. The full document, with appendices that contain details on participants and discussions is available by contacting the ICAN office by email (<canopy@elwha.evergreen.edu>) or by regular mail (see address on the back cover of this newsletter).]

I. INTRODUCTION

The forest canopy has been termed "the last biotic frontier", and is one of the richest but most poorly studied habitats in our biosphere. The canopy is the place where life meets the atmosphere, and where a tremendous amount of sunlight energy is transformed, stored, and transferred via litterfall, herbivory, and harvesting. The canopy is the setting for recording biological diversity and building factual foundations to answer basic questions about evolution and ecology. Forest canopies also provide many values that are aesthetically and spirtually important to humans. Solutions to current environmental and social issues at regional and global scales (e.g., sustainable forest use, global climate change, loss of biodiversity) are related directly to our knowledge of forest canopies.

Study of the forest canopy has reached a critical stage in its development, being transformed from a young field based on descriptive studies carried out by individual researchers, to a vibrant and emerging field of investigation that is increasingly experimental and predictive in nature. Communication of research results are extending to allied scientific fields, decision-makers, and the general public. Groups of researchers are just now beginning to coalesce across national and traditional disciplinary borders.

As part of this process, two international canopy research meetings were held in 1998. Results from those meetings inspired a group of European and North American canopy researchers to convene a workshop to initiate a global integrated program in forest canopy research. In November, 1999, 29 scientists from nine countries participated in the workshop, which was held in Oxford, U.K.

The goals of the workshop were to:

· initiate planning for a global integrated program in forest canopy research;
· articulate a central research vision and develop a set of long-term, broad-scale research hypotheses and questions for canopy scientists to address;
· determine the technical tools and research resources needed to answer these questions; and
· forge partnerships and communication pathways for collaborative research projects that are based on harmonized methods and result in accessible research databases.

Support for European participants came from the Tropical Canopy Programme of the European Science Foundation (ESF), and for North American participants, from the International Programs section of the National Science Foundation (NSF). Because these funding sources constrained support to a limited number of scientists from specific countries, we initiated the meeting by recognizing that the participants at the workshop represent only a subset of the expertise and activities of canopy researchers around the world. We agreed that this meeting would serve as a starting point from which scientists from other countries will have numerous opportunities to contribute, both in future meetings and via electronic communication. To broaden the input beyond the immediate participants at the conference, we established a website prior to the workshop to disseminate preparatory documents, gather input from those not at the meeting, and to distribute the meeting reports following the workshop (www.evergreen.edu/ican).

This report summarizes the major activities and decisions made at the meeting; more detailed appendices are attached.

Participants at the workshop reviewed a draft report. This revised report will be disseminated via the newsletters, email bulletin boards, and websites of the International Canopy Network and other research organizations (e.g., Ecological Society of America, European Tropical Forestry Research Network, Organization for Tropical Studies, International Union of Forest Research Organization).

II. MEETING ACTIVITIES

A. SUMMARY OF EXISTING RESEARCH

Participants first summarized the state of the art of canopy research to identify subject areas and geographical locations that have been studied and to recognize topics and regions that remain understudied or unknown. To establish a common knowledge base, G. Parker presented set of definitions of the canopy and described the importance of its study, the scientific fields that contribute to our understanding of canopy organisms and processes, and recent trends in canopy research. These include multi-disciplinary work, application

of experimental and modelling approaches, use of multiple study sites, and work at larger spatial scales using remote sensing technology.

An overviewof past and current research and costs of operations at five access-based research sites was presented: Smithsonian Tropical Research Institute cranes (Panama), Wind River crane (Washington State), Suromoni crane (Venezuela), Tropical Rain Forest Centre crane (Australia), and the Canopy Operation Permanent Access System (COPAS, French Guiana).

Representatives of ongoing canopy research groups reported their foci and activities: the IUFRO Canopy Processes/Physiology group, the Long-term Ecological Research group (NSF), and the Canopy Science Database project. These descriptions and examples provided models and helped avoid redundancy for the integrated research visions we created later in the workshop.

Consideration was also given to the history of other more "mature" fields of scientific endeavor and global research projects (Human Genome Project, Hubble Telescope, Plant Genome Project) to guide us in our quest to develop our field in the most efficient manner possible. We reviewed retrospective articles and integrated websites that were referred to us by senior researchers involved with those fields. We learned that the development of these large-scale projects has required:

· scientific and communication efforts on the order of decades that drew upon a cadre of scientists who channeled their individual research efforts towards the common good of the research community;
· organization of inclusive meetings to create consensual documents that articulated scientifically sound and clear, easily accessible strategic plans;
· establishment of training programs at the undergraduate, graduate, and technical/practitioner levels;
· accumulation of a critical mass of data accessible to multiple researchers that allows patterns to emerge and predictions to be made and tested;
· management of data and accompanying metadata to ensure the preservation, availability, and interpretation of information;
· timely coincidence of a perceived need for research in that field (i.e., the perception that there were direct benefits of basic research in that field for humans);
· technological breakthroughs that overcame previous limitations in collecting or analyzing data;
· maintenance of a coordinating body that included active scientists and individuals who are excellent communicators to policy makers and the general public.

We agreed that the field of canopy research is moving toward a "jump" in scale, approaches, and activities.

B. IDENTIFICATION OF OBSTACLES AND NEEDS:

Obstacles to making progress in a global canopy research program were identified, which fell into three classes:

· Technical/logistical issues (e.g., inadequate training programs, lack of easily used three-dimensional visualization tools, insufficient infrastructure at research sites);
· Intellectual/academic issues (e.g., inability to make sound transformations between spatial scales, pseudoreplication of within-tree study plots); and
· Other issues (e.g., lack of perceived relevance of canopy research from the public, a bias towards study sites in primary forests (rather than managed or second-growth forests)).

The group also generated a list of needs and functions to coordinate a global canopy research program. These include:

· maintenance of communication pathways among researchers, e.g., newsletter, email bulletin board, meetings, symposia;
· establishment and maintenance of a long-term data repository for access and exchange of databases on: canopy researchers, projects, funding sources, study sites, datasets with accompanying metadata, methodologies, visualization and analysis programs, scientific citations, video images, and popular articles;
· coordination of training programs;
· harmonizing research protocols within and across forest study sites;
· creation and dissemination of education/outreach and public relations materials to decision-makers and the general public.

C. ARTICULATION OF RESEARCH QUESTIONS AND HYPOTHESES

A key function of the workshop was to identify a set of questions and hypotheses that researchers can jointly address by implementing a global canopy research program. We generated a list of these questions from individuals, and then organized them into five themes that were discussed in small working groups. Subjects were: 1) biodiversity; 2) global processes; 3) theory and integration; 4) structure-function linkages, and 5) socio-economic implications. The task of each group was to refine the questions and integrate them into our proposed global canopy research program by discussing and reporting upon the following questions:

· What large-scale programs and resources do we need?
· What resources do we already have for these programs?

· How do these programs address societal interest and global concerns?

Common themes across all of the working group reports were:
· infrastructure with a permanent staff is needed to support the research communication;
· field sites must be linked, and methods of data collection, storage, and analysis should be harmonized to allow for comparative research;
· databases and data repositories with common "join points" are needed to store and exchange data.

We also articulated a larger, more general research question that would elevate aspects of this discussion to a substantial intellectual level, justify expansion of the current number and types of sites, coordinate individual findings, create a common data management systems, and develop cross-system, interdisciplinary research efforts. This general question can serve as a framework for proposals to agencies such as NSF, which seek exciting, scientifically sound issues to fund.

How does structural and biological complexity affect ecosystem function, persistence and resilience? The range of complexity among forest canopies make them ideal laboratories to discover new species and processes, to test ecological principles under comparative conditions, to develop new theoretical frameworks, and to identify innovative forest management strategies.

D. APPROACHES TO INITIATE A GLOBAL CANOPY RESEARCH PROGRAM

We recognized that we can already begin to address some of the questions raised at the workshop by drawing on the growing body of scientific information on forest canopies and existing field sites that have access mechanisms. We developed a framework from which to build further, which we termed the "Global Canopy Research Matrix" (Table 1).

We tallied the types of data that do and do not exist for fields of study at canopy research sites that represent a variety of climatic regimes and forest structural types. This matrix will help guide us in prioritizing forest types in which particular types of research should be proposed in order to carry out comparative research.

We noted that many other active long-term research sites at which researchers study the canopy already exist - particularly for ecophysiology and functional studies, e.g., boreal forests of Scandinavia, sites in the Free Air Carbon Emission (FACE)

Table 1. Global Canopy Research Matrix

Acess systems, research concentration, and ecological background of existing forest canopy research centrers presented as a table with research centers by column and resource categories by row. The areas of research concentration are divided into measurements of canopy structure, the diversity and ecology of canopy inhabitants, and significant canopy processes. The intensity and variety of available information is indicated with qualitative classes.

CANOPY RESEARCH SITES/ INFORMATION	AUS	COP	DAN	HOK	MV	PAN I	PAN II	SERC	SUR	WR
Access Methods	TC	ST	ST, SRT	TC	SRT	TC	TC	SRT,MC, ST	TC, SRT	TC, SRT
Structural Attributes										
Crown	I	III	O	III	O	III	II	II	III	III
Stand	I	III	O	II	III	I	III	III	III	III
Landscape	O	O	O	--	III	O	II	I	I	I
Biodiversity										
Trees	II	II	II	I	III	II	II	III	III	III
Canopy Plants	I	II	O	--	III	II	III	I	III	III
Insects	II	I	I	--	III	III	III	--	I	II
Birds	--	O	II	--	I	I	I	I	III	III
Bats	--	O	O	--	I	I	O	--	--	II
Other vertebrates	I	O	I	--	O	II	O	I	II	I
Fungi	--	--	O	--	I	II	II	--	I	I
Functional Attributes										
Radiative Balance	III	--	O	--	O	II	II	III	III	III
Photosynthesis	--	II	O	--	I	III	I	II	--	III
Transpiration	--	--	O	--	O	III	I	II	II	III
Water Balance	II	--	O	--	O	III	O	III	III	II
H_2O/CO_2 Flux	II	--	O	--	O	O	O	II	II	III
Primary Production	--	--	O	--	O	I	II	III	--	III
Herbivory	--	--	O	--	I	III	III	I	--	II
Decomposition	--	--	O	--	O	O	O	III	--	II

KEY	
SITES:	**"FUTURE SITES"**
AUS = Australia	Dry Tropical (Chamela, Mexico)
COP = COPAS, Guyana	African Tropical
HOK = Hokkaido, Japan	Boreal
MV = Monteverde, Costa Rica	Borneo
PAN I = Panama, dry site	Dry Temperate
PAN II = Panama, wet site	Managed
SERC = Smithsonian Env. Res. Ctr, Maryland USA	Taiga
SUR = Surononi, Venezuela	Western European
WR = Wind River, Washington USA	
ACCESS:	**AVAILABLE INFORMATION:**
TC = Tower Crane	III = MUCH
ST = Stationery Tower	II = SOME
MC = Mobile Crane	I = LITTLE
SRT = Single Rope Technique	O = NONE
	-- = UNKNOWN

project, and the forested Euroflux and Ameriflux sites (>60). We recognized that we have valuable canopy research that is already being placed in ecosystem and regional contexts, and it may be beneficial to initiate or enhance species and biodiversity studies at these sites, as well as initiating new sites.

We brainstormed ideas for projects that would draw upon a set of sites with harmonized techniques. Dr. G. Parker described a study that characterized the vertical and horizontal light environment using a simple balloon technique at several of the existing sites, and could be carried out at others. The project resulted in quantitative light profiles across forests of very different structure and composition, which revealed some exciting results about the energy-capturing capacity of forest canopies. Other such studies include vertebrate exclosure experiments to determine the importance of vertebrates in controlling herbivory, structure/function relationships across a canopy structural diversity gradient within a single bioregion, and use of LIDAR technology to quantitatively describe and visualize canopy structure at the landscape level.

We also discussed the need for a set of databases that would make such comparative datasets and other canopy research-related information accessible to the international cadre of canopy researchers. Dr. J. Cushing outlined preliminary work she and her colleagues have been doing in collaboration with active canopy researchers in the USA, and invited others to augment and refine these databases.

We discussed general approaches to raising funds for this major canopy program. Dr. W. Moomaw outlined his work with the US$6 billion Intergovernmental Panel on Climate Change. He pointed out that relying solely on sentiments concerning "arbophilia" or "beetlemania" may not result in significant funding. Rather, we must demonstrate both intellectual and applied significance in a global proposal. This process should follow the standard pattern of observation: theory: modeling: prediction.

The canopy has the ideal combination of the excitement of an undiscovered world, considerable application, and the need for major hardware to get the job done. This kind of combination is what has succeeded in the past in other fields. Canopy studies can help governments implement Conventions on climate change and biodiversity; links to major existing treaties is also an advantage. Agencies that coordinate research that may appear to be outside of forest canopy studies should also be tapped, e.g., NASA needs applications for its space hardware and could become an ally for this program.

E. ENHANCEMENT OF A COORDINATING RESEARCH BODY:

One of the primary needs identified for our research community is the maintenance and enhancement of a coordinating organization that can provide infrastructure and staff to maintain avenues of communication, serve as a repository of data and resources, and coordinate and integrate research at different study sites (see Section II.B).

There was consensus that these needs should be met by expanding the existing USA-based International Canopy Network (ICAN), a non-profit organization whose mission is to enhance communication among forest canopy researchers, educators, and conservationists. Workshop participants recognized that US scientists dominate its current membership, and that efforts are essential to "internationalize" the group, expanding to include the extensive canopy research network in Europe and the significant groups in Japan and elsewhere. ICAN should be developed to include key representatives from centers of expertise in developing nations, especially those with tropical forests. A subset of individuals at the meeting agreed to serve as liasons for their countries, and recommendations were made for countries that were not represented at the workshop.

The proposed structure for this coordinating body would be a "centributed" organization with one (or possibly two) headquarters. We would extend the existing structure of the ICAN, which has non-profit 501(c3) status. Governance is currently by a Board of Directors serving three-year terms, with a President, Vice-President, Secretary, and Treasurer. An Advisory Board consisting of members with expertise ranging from environmental law to childrens' education, provides oversight to the Board of Directors. An Executive Direct and/or his/her Assistant would implement programs and be responsible for operations, with input from the Board of Directors and the Advisory Board. Regional coordinators will provide links for broad geographical areas (North America, South America, Africa, Asia, Europe). Country liasons will provide more local contact with the members at large. As with current

ICAN practices, the Board will meet annually to review progress and chart future plans. ICAN representatives would have a presence at national and international meetings relating to research, education, and conservation, and function as the global professional body for those involved with forest canopies (Fig 1).

High priority for post-workshop actions was placed on investigating means of ongoing support for this work. Several participants volunteered to draft a proposal and budget and to approach potential funding sources immediately after the meeting.

A. COMPOSITION OF A JOINT RESOLUTION:

Participants jointly composed and refined the following joint resolution, which could serve as the core of a strategic plan for our research community:

***Whereas*:** Forest canopies are crucial to biosphere health because they house the photosynthetic machinery of the biosphere, influence the exchange of energy and matter with the atmosphere; and maintain habitat for organisms, and are in peril of loss and fragmentation due to human activities;
Whereas: little is known of forest canopy organismal diversity, interactions, and functions in ways that allow explanation and prediction;
***Whereas*:** the study of canopies has emerged as a vigorous area of scientific study that has grown from individualistic efforts to an interconnected field with a broad array of powerful access tools, methods, and focused objectives that has become increasingly organized, interdisciplinary, and mechanistic in outlook;
Whereas: the study of forest canopies has a clear potential for making a contribution to policy and management issues; maintaining global biodiversity, global environmental conditions, and the sustainability of forests.

We propose 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 sustainablility of forests.

To do this, we will develop an international, interdisciplinary research and outreach program built around an existing coordinating body (the International Canopy Network), and a network of existing and proposed study sites across forest biomes and management systems.

G. NEXT ACTIONS AND ACTIVITIES:

Participants identified a set of planning and implementation activities to be undertaken within the next two years, and determined a time schedule and individuals responsible to carry these out. One key activity is the organization and planning for the next international canopy conference, to be held at the Tropical Rainforest Research Centre (the site of the Australian canopy crane) in November 2001. N. Stork, the Director, made a plea for help with the planning, especially to raise funds to support scientists from developing countries. He proposed that staff at the ICAN be responsible for as much of the logistical planning as possible. Other interim meetings are planned in various parts of the world, and these will ensure continued contact among members of the canopy research community.

III. WORKSHOP OUTCOMES AND ACCOMPLISHMENTS

A. CONFLUENCE WITH RESEARCH STRATEGIES OF OTHER INSTITUTIONS:

We recognize that our research goals are congruent with objectives of several major international scientific initiatives. We agreed to pursue funding opportunities from these and other sources.

1) The missions we articulated are closely tied to the general strategic goal of the National Science Foundation, to "promote the discovery, integration, dissemination, and employment of new knowledge in service to society". Our research objectives are congruent with the specific goals of NSF's recent Biocomplexity Initiative. Biocomplexity refers to phenomena that result from dynamic interactions among the biological, physical and social components of the Earth's diverse environmental systems. Biocomplexity arises from the interplay between life and its environment, i.e., from the behavioral, biological, social, chemical and physical interactions that affect, sustain, or are modified by living organisms, including humans.

2) The mission of the European Science Foundation is "to promote high quality science,… facilitating cooperation and collaboration of European science on behalf of its principal stakeholders, and providing scientific leadership through its networking expertise and by ensuring that there is a European added value to all of its initiatives and projects." The workshop itself fulfilled this mission by bringing together European and North American researchers, and providing the opportunity to forge collaborative research projects across continents in the future.

3)In 1991, **The Ecological Society of America** put forth the **Sustainable Biosphere Initiative (SBI**), an initiative that "focuses on the necessary role of ecological science in the wise management of Earth's resources and the maintenance of Earth's life support systems." They recognized that "many of the environ-

mental problems that challenge human society are fundamentally ecological in nature, so ecological understanding of complex phenomena is essential if society is to anticipate and ameliorate the environmental consequences of human activities." They established three research priorities: global change, biological diversity, and sustainable ecological systems. All three of these priorities are congruent with the areas of forest canopy research that emerged from this workshop.

B. SUMMARY OF OUTCOMES AND ACCOMPLISHMENTS OF THE WORKSHOP:

Consensus on the compelling need for a global integrated program of canopy research;

· Agreement to put forth effort to be as inclusive as possible in the global canopy research planning and implementation processes, especially to bring together representative scientists from tropical and developing countries;

· Identification of common research interests and joint research efforts to test particular hypotheses that would involve comparative and harmonized research;

· Re-affirmation that the existing International Canopy Network should be the coordinating body of the global research program;

· Establishment of a roster of researchers from representative countries who will take responsibility for coordination and communication

· Development of an action plan with a timeline and budget;

· Fostering a sense of urgency, collegiality, cooperation, and responsibility among an international cadre of canopy researchers

ACKNOWLEDGMENTS

The workshop co-coordinators (E. Linsenmair, B. Fiala, N. Nadkarni, and A. Mitchell) thank all participants for their input and insights. We gratefully acknowledge the diligent note-taking by Steve Rentmeester. As an observer, W. Moomaw presented many insights and helped us greatly in placing our discussions into a broader context. We acknowledge funding from the Tropical Canopy Programme of the European Science Foundation and the International Programs group of the National Science Foundation (INT 9981531). Logistical help came from Catherine Lobstein at the ESF, Jeanne Hudson at the NSF, and Lorri Moore at The Evergreen State College, and Amber Neilsen at the International Canopy Network. This revised workshop report is submitted by Nalini Nadkarni, February 15, 1999.

FUNDING OPPORTUNITIES

World Environment and Resources Program. This program was created by The John D. and Catherine T. MacArthur Foundation to address issues in tropical ecosystems of global change, conservation, education, and sustainable development. Grants are provided in such areas as biological inventory, biogeography, ecological research, education, and conservation studies. Contact: The John D. and Catherine T. MacArthur Foundation, 140 South Dearborn Street, Suite 1100, Chicago, IL 60603, USA; Phone: (312)-726-8000; <<http://www.macfdn.org/index.htm>>.

Center for Field Research funds projects to investigate and/or preserve the physical, biological, and cultural heritage of the planet. Areas of possible funding include deforestation, sustainable agriculture programs, and projects designed to study the role of biodiversity and loss of species in the functioning of ecosystems. Interdisciplinary and multinational projects are encouraged. Contact: *The Center for Field Research, 680 Mount Auburn Street, P.O. Box 1904, Watertown, MA 02272, USA; Phone: (617) 926-8200; Fax: (617) 926-8532; <<www.earthwatch.org/cfr/cfr.html>>.*

Organization for Tropical Studies is dedicated to education, research, and the wise use of natural resources in the tropics. OTS provides grants for U.S. and Latin American graduate students doing graduate field research in tropical biology and related fields to promote interchange of professionals for biological research and education. Research can be performed at OTS field stations in Costa Rica or other locations. Contact: *Organization for Tropical Studies, Inc. (OTS), North American Headquarters, Box 90630, Durham, NC 27708-0630, USA; Phone: (919) 684-5774; Fax: (919) 684-5661; In Costa Rica: Phone: (506) 240-6696; Fax: (506) 240-6783; <<http://www.ots.ac.cr/>>.*

The Forest Research Institute Malaysia (FRIM) Research Fellowship Grant provides funding for prominent scientists to conduct research in collaboration with members of the FRIM on forestry and forest products in Malaysia. Grants are awarded up to US$10,000 as well as return air and living accomodations. The program also awards fellowships for postgraduates to perform research at the FRIM. Contact: *The Forest Research Institute Malaysia (FRIM), Kepong, 52109 Kuala Lumpur, Malaysia; Phone: (603) 634-2633; Fax: (603) 636-7753; <drsalleh@frim.gov.my>.*

Announcements

A Coleoptera list-serv is now available for group discussions and an up-to-date interactive calendar of events. To subscribe, visit: *<<http://www.egroups.com/list/coleoptera/>>* or send an empty e-mail to: *<coleoptera-subscribe@egroups.com>*.

Southeast Environmental Research Center (SERC), of Florida International University, promotes, coordinates, and conducts interdisciplinary environmental research on tropical and sub-tropical ecosystems in the southeastern United States and the Caribbean. Contact: *Leonard J. Scinto, Ph.D., Southeast Environmental Research Center, Florida International University, Miami, FL 33199 USA; Phone: 305-348-1965; Fax: 305-348-4096; <scintol@fiu.edu>; <<http://www.fiu.edu/~serc/>>*.

The Iracambi Atlantic Rainforest Research Center, in Minas Gerais, Brazil, provides the facilities for visiting researchers. The Center also acts as a focal point for a forest land management program with local communities, in which relevant research from the Center and elsewhere is applied in the development of sustainable land management practices and policies. This work is carried out by Amigos de Iracambi, a registered civil association (NGO). Amigos also works with local communities, associations, and schools to highlight environmental conservation, deforestation and other related issues. Contact: *Robin Le Breton; <research@iracambi.com>; <<www.iracambi.com>>*.

The Smithsonian Institution's Monitoring and Assessment of Biodiversity Program is offering two courses in Washington D.C. for conservation biologists, educators, ecologists, resource managers, and environmental leaders. The Biodiversity Assessment and Monitoring for Adaptive Management course, (May 14-June16, 2000) is an intensive 5 week guide through the process of designing and implementing local and regional biodiversity monitoring programs. The Environmental Leadership course (September 10-22, 2000) stresses essential communication skills and strategies to facilitate interaction with managers, decision-makers, and resource personnel. Contact: *Christopher Ros, SI/MAB Program, Smithsonian Institution, National Museum of Natural History, 10th and Constitution Ave NW, Washington, D.C., USA, 20560-0180; Phone: 202-786-3116; Fax: 202-633-8918; <cjr@ic.si.edu>; <<www.si.edu/simab>>*.

Meetings of Interest

Challenges And Limitations Of Optimality Approach In Plant Ecology. Hyytiälä, Finland. April 9-12, 2000. This workshop at the Hyytiälä Forestry Field Station of Helsinki University will review recent advances in the application of the optimality approach in plant ecology and examine the problems and challenges facing the use of the approach in botany. Contact: *Maarit Raivonen; <Maarit.Raivonen@helsinki.fi>*.

Annual Meeting of The Association of Tropical Biology. Indiana, USA. June 23-27, 2000. This will be a joint meeting of The Association of Tropical Biologists, The Society for the Study of Evolution, The Society of Systematic Biologists (SSB), and The American Society of Naturalists. Talks, symposia, and poster sessions will cover topics such as adaptation and applied evolution. Contact: *Michael J. Wade, Department of Biology, Indiana University, Jordan Hall 142, 1001 E. Third Street, Bloomington, IN 47405-3700; Phone: 800-933-9330; <mjwade@indiana.edu>; <<http://atb.botany.ufl.edu/index.html>>*.

World Conference on Natural Resource Modeling. Wageningen, Netherlands. June 26-30, 2000. The theme of this meeting of the Resource Modeling Association (RMA) is The Ecology of Scale. This conference will address the importance of scale to the understanding of ecological systems. Though the emphasis will be on spatially explicit models any topic will be considered. Contact: *<<http://www.slm.wau.nl/natcons/RMAconf/>>*.

Integrating Geographic Information Systems (GIS) and Environmental Modeling. Alberta, Canada. September 2-8, 2000. This 4th International Conference on Integrating GIS and Environmental Modeling will address the role of GIS and modeling in understanding human-environment interactions. The intent of the conference is to improve predictive methods and techniques, including types of quantitative models for environmental problem solving. Contact: *Conference Director, Dr. Bradley Parks, Cooperative Institute for Research in Environmental Sciences (CIRES), Campus Box 216, University of Colorado, Boulder, Colorado, USA, 80309-0216; Phone: 303-497-6330; Fax: 303-497-6513; Conference Secretariat <GISEM4@colorado.edu>; <<http://www.colorado.edu/research/cires/banff/>>*.

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).

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