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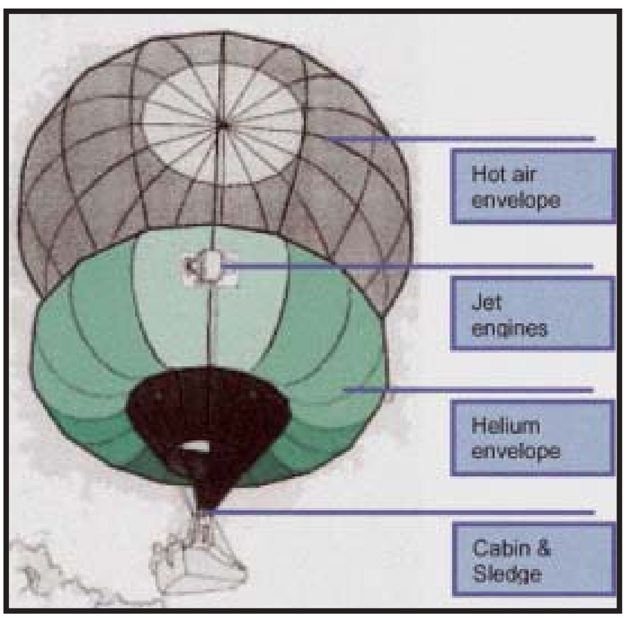
WHAT'S UP?

THE NEWSLETTER OF THE INTERNATIONAL CANOPY NETWORK

NALINI NADKARNI, EDITOR DAVID FRANKLIN, EDITORIAL ASSISTANT

Global Canopy Programme 20:20 Vision for Canopy Science

The plan for a global network of "Whole Forest Observatories" developed by the GCP Steering Committee to monitor the impact of climate change on biodiversity in temperate and tropical forests is taking shape. Following the 'Canopy Summit' last July, the GCP has developed a detailed project development proposal to submit to the Global Environment Facility (GEF) of the World Bank through UNEP. Partnerships have now been established in Brazil, Ghana, India, Madagascar, and Malaysia for the project. A GCP report, "*Canopy Summit: A 20:20 Vision for Canopy Science*", which calls for the network to be created, will be released in February 2004. We will also release a related GCP supported publication "*Environmental Crisis: Climate Change and Terrestrial Biodiversity in Queensland*", which will be presented to the Premier's Office in Brisbane, Australia. A landmark publication that appeared this past January in *Nature*, "*Feeling the Heat*", predicts that 15-37% of species at risk could become extinct by 2050 as a result of climate change. This article, along with our efforts, are helping to raise international interest surrounding the impact of climate change on biodiversity. Because the biggest impact will be in forest canopies, where most of the biodiversity occurs, the timing of the GCP call for a network of observatories to help monitor and assess this change seems timely.



Artist impression of the proposed Canopy Glider

UK NATIONAL FOREST OBSERVATORY

Since June 2003, GCP Project Officer John Pike has been carrying out a feasibility study, funded by the Esmée Fairbairn Foundation, to investigate the need for a major forest canopy research facility in the UK. The study has sought opinion of the scientific community in the UK regarding canopy research and investigated the possibility of establishing a national canopy access facility in British Woodland. It has engaged scientists with diverse backgrounds, from biodiversity, climate change, and forest ecophysiology to airborne laser mapping and other remote sensing technologies and has encouraged a wide community of researchers to think about the possibilities of UK canopy science and the ways in which it can be linked into the European and Global network through the GCP. A workshop this February will build on the high level of interest in a canopy facility within the UK scientific community. A UK consortium has now been brought together to develop the project with the GCP and work-up a proposal for UK government funding.

(continued on page 6)

Forest management effects on the vascular epiphyte community in semideciduous forests of the Biosphere Reserve "Península de Guanahacabibes", Cuba

The biosphere reserve "Península de Guanahacabibes" is located in the westernmost region of Cuba. It covers an area of 101,500 ha, of which 26,000 ha make up the terrestrial area of the Guanahacabibes National Park. Of the existing vegetation types, the semideciduous forests have been most affected by the impacts of the forest economy. The practices of forest management negatively affect the ecosystem because of the modifications of the structure, composition, and density of the forest. These effects may also include changes in the structure and dynamics of the vascular epiphyte community, which has never before been evaluated in the biosphere reserve.

To research this question, we measured 45 plots (625 m^2) in the semideciduous forest, which covers a total area of 2.8 ha. The sampling was stratified in three sectors of the peninsula and in three age classes (2-5 years, 12-15 years and > 35 years). Trees, shrubs, and lianas were measured, the phorophytes were identified, and all vascular epiphytes present in each one of the phorophytic zones were counted using the Johansson classification, modified by Ferro-Díaz *et al.* 2000).

We found a species richness of 118 species of trees, shrubs, and lianas in the sampling areas. These represent 17.5 % of the total flora reported in the biosphere reserve. The total sample was 10,885 individuals in 2.8 ha, which represents a density of 3,888 individuals per ha (Ferro-Díaz 2003).

We found 50 species of vascular epiphytes belonging to 31 genera and 19 families. Such diversity corresponds to the following types of epiphytes: true epiphytes, hemiepiphytes, climber semiepiphytes and occasional epiphytes. The richness described for Guanahacabibes is higher (in the total of families) than those reported for the rest of the country, indicating that there has been an insufficient assessment of these communities in Cuba. The epiphyte quotient was 42.4 %, higher than reported by Ferro-Díaz *et al.* (2003) for Guanahacabibes marshy forest (33.3 %).

Of the total families of vascular epiphytes found, Bromeliaceae and Orchidaceae had the greatest diversity. The total abundance was 6,313 individuals, representing a density of 2,255 individuals per ha. The most abundant species with the greatest frequency were *Tillandsia fasciculata* (Bromeliaceae) and *Encyclia* sp. (Orchidaceae).

This research showed that the impact of the selective tree cutting had a more significant effect on vascular epiphyte abundance than on species richness. The abundance of epiphytes had a tendency to increase over time (Fig. 1).

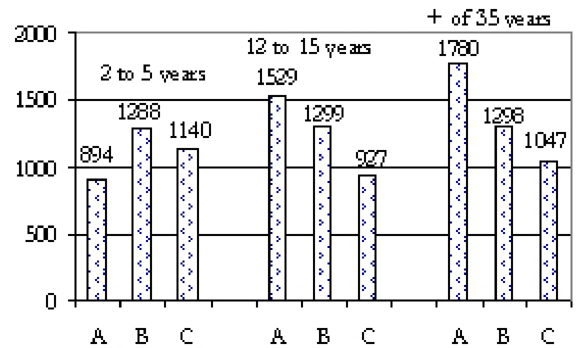


Fig. 1. Distribution of the abundance of trees, shrubs and lianas through the stages of post selective trees cutting in each of the sectors of the peninsula (A is West, B is Center and C is East).

The impacts of management practices are also reflected in the abundance of *Tillandsia fasciculata* in its later successional stages. The effect of tree cutting on abundance occurs over time (Fig. 2), with a rapid increase from the first 2-5 years to a maximum at the 12-15 years stage. Later, this impact diminished as forest structure was restored. There was a high correlation with the decrease of the abundance of the species, indicating that that *T. fasciculata* is a plant with preferences for direct sunlight that takes advantage of tree and shrub removal inside the forest. Its distribution can expand quickly, which is why it is considered as an invasive species.

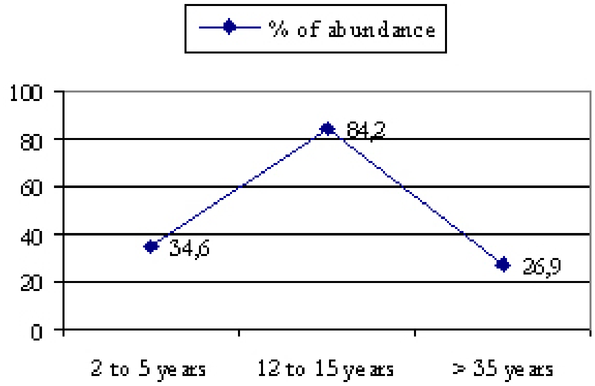


Figure 2. Dynamics of the abundance of *Tillandsia fasciculata* (Bromeliaceae) in three later stages to the impact of the forest management.

In the analysis of the distribution of the total abundance of the epiphyte in sectors of the peninsula (Figure 3-A), we detected an increase in abundance from west to east. This is the opposite of what happens to the abundance of trees and shrubs. Thus, forest management practices that produce gaps by removing trees from the forest create conditions for epiphytes like *Tillandsia fasciculata* to expand quickly and become dominant in the community.

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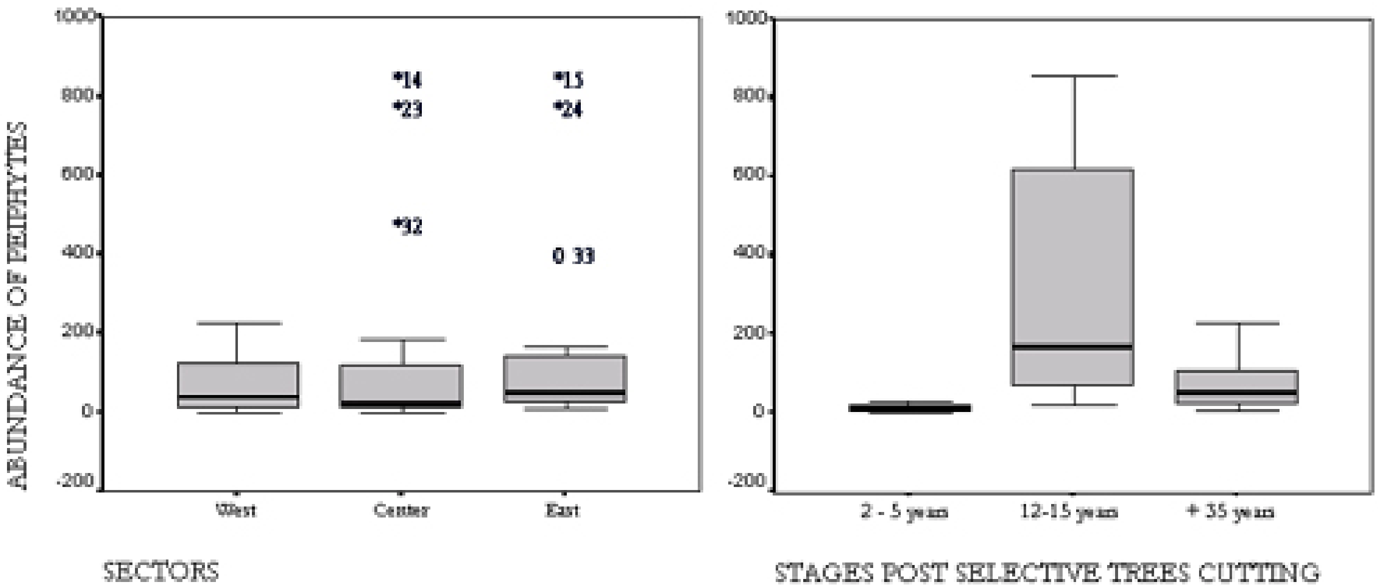

Fig. 3. Distribution of the abundance of vascular epiphytes by sectors (A) and stages post selective trees cutting (B).

With respect to the effects of post-selective tree cutting (Fig. 3-B) during the first 2-5 years, the community of vascular epiphytes showed a low abundance as a consequence of the management impact. However, 12-15 years later, their abundance increased significantly. This period is also related to the largest percentage in canopy openings. There is a tendency of the population abundance to decrease and the species richness to increase in stands > 35 yrs.

We analyzed the distribution of epiphytes in proportion to the size of trees. Vascular epiphytes are disproportionately distributed on trees of larger diameter. In another analysis, we found that a strong correlation does not exist within the architecture of phorophytes in the general distribution of epiphyte abundance. Nevertheless, we observed that there was a preference for trees with the rough bark, which are larger. This is relevant because of the decline in large trees due to the impacts of forest management.

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Diversity of lignicolous fungi in the canopy of a deciduous forest in Leipzig, Germany

Introduction

Fungi are important parts of almost every ecosystem, especially of forest soils. However, ecological investigations have largely ignored them as important members of the canopy. The few studies that have been conducted are mostly short-term projects, focusing on the understory or studies in tropical forests (e.g. Boddy 1992, Hedger *et al.* 1993, Nuñez 1996). To fill this gap, we started a long-term project on the diversity and ecology of wood-inhabiting fungi in the canopy of a mixed deciduous forest in Leipzig (Central-east Germany). The study is part of the Leipzig Canopy Crane Project (Morawetz & Horchler 2002).

As with poroid and corticioid fungi, Pyrenomycetes are well-known wood dwellers of dry, exposed habitats. Different systematic groups of Discomycetes (*Leotiales* s.l.) also prefer such conditions (Sherwood 1981). Our studies focus on diversity patterns, substrate preferences and community structures of lignicolous fungi on trees between heights of 10-34 m.

Methods

Dead wood of 30 individual trees (mainly ash [*Fraxinus excelsior*], oak [*Quercus robur*] and lime [*Tilia cordata*]) was collected in autumn 2002 and spring 2003. Twigs and branches were collected with a maximal diameter of 6 cm and a maximum length of 1 m. We tried to get the same quantities from sub- (10-18 m), middle (18-26 m) and upper canopy (26-34 m). To allow fructification of established mycelia and further growth of fruit body initials, the samples were stored for two weeks in high humidity. Only teleomorphic species (fungi with meiotic spores) and anamorphs (fungi with asexually produced spores [conidia]) that grew in deeper layers of bark and wood were tallied.

Results and Discussion

A total of 85 species of 62 genera were identified. As expected, many of the fungi had xerotolerant or xeroresistant fruiting bodies. Fruiting bodies of lignicolous agarics were almost completely absent in the canopy. A total of 40 species (47 %) were singletons. Some frequently found species had been rarely recorded in Germany. Further studies will surely increase the number of species because: (a) many specimens could not be identified due to poor stages of development; (b) many species form tiny and short-lived fruiting bodies that are easily overlooked, and (c) many fungi fructificate only sporadically and under certain climatic conditions.

The fungal species richness of some host trees differed. We found 13 species on *F. excelsior*, 21 on *Qu. Robur*, and 37 on *T. cordata*. Possible reasons for this variability are different antimicrobial defences in the bark and wood of the trees (Pearce 1996) and different morphological-anatomical characteristics (lime wood is soft oak and ash wood compact and hard).

In the canopy, fungi must be adapted to the severe climatic conditions to successfully complete their life cycle. Such adaptations occur especially in species that were found mostly in the upper canopy. Species with slow fruiting body development (over a period of weeks or even months) must be able to dry out without damage or to prevent complete desicca-

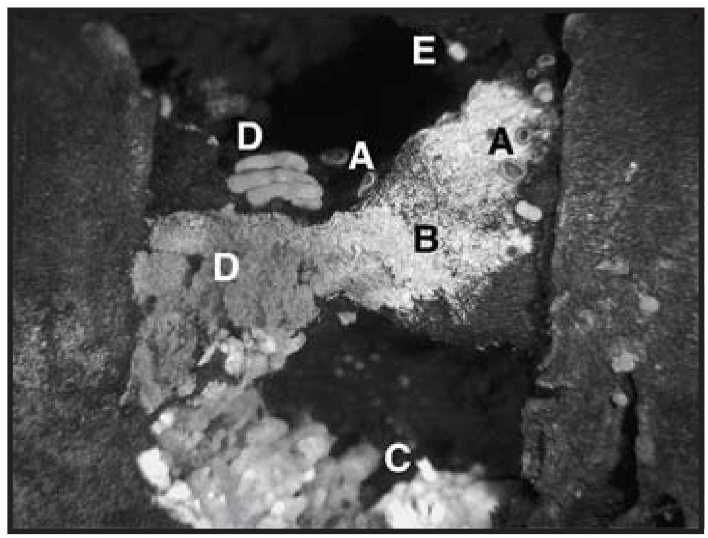

Fig. 1: Cryptogamic species in a microenvironment

tion (Bewley 1979). Characteristic representatives are the Pyrenomycetes; thethree most abundant pyrenoid species were represented with 40.5% in the upper canopy. Their abundance decreased to 13.5% in the middle and 6% in the lowest canopy stratum. In the upper canopy, xerotolerance seemed to be more important than the speed of development, whereas the slow growth rate of Pyrenomycetes is probably detrimental in lower and more humid areas that are less exposed to solar radiation.

Figure 1 shows how difficult the investigation of the ecology of lignicolous fungi in the canopy can be. The image covers about 5 cm^2 of a weathered branch of a cherry tree (*Cerasus avium*). The bark on the left and on the right is still attached to the branch, and two cavities are present in the decorticated, heavily decayed area in the middle. Altogether, 5 different fungi and slime molds (*Myxomycetes*) can be identified: *Mollisia sp.* (A), an ascomycete, on *Hyphoderma setigerum* (B), a basidiomycete, on wood deeper inside the gap. A second Hyphoderma species, *H. radula* (C) grows in close vicinity. The 2 slime mold species are *Arcyria denudata* (D) and *Arcyria cinerea* (E) in the background.

The following overview of some strategies to survive in the canopy shows the diversity of possible interactions and adaptations.

1. Fungi such as *Resupinatus trichotis* are facultative nematophages. They gain advantage over other fungi by using small invertebrates as optional food resources.
2. Many genera (e.g. *Orbilia*, *Mollisia* or *Episphaeria*) grow and fructificate on algae layers, old fruiting bodies of other fungi, or partly dried plasmodials of slime molds. In such organic matter, humidity prevails longer than on the surface of naked wood.
3. Unlike agaric fungi whose fruit bodies grow upright (negative geotropism) and would rapidly desiccate in the windy and dry canopy very rapidly, fungi of the families Corticiaceae, Hymenochaetaceae, Stereaceae or Polyporaceae grow mostly underneath horizontal and oblique branches and are closely attached to the substrate (Fig. 2). Therefore they escape harmful UV radiation and rapid desiccation.They are able to use humidity efficiently.
4. Cyphelloid fungi, minute plate- or cup-shaped basidiomycetes are plastic. Under humid conditions, their fruit bodies emerge quickly on the upper side of branches. However, they can survive arid periods by taking a spheroidal shape when their tissues dry up, thus enclosing the fertile, damageable structures of the hymenium and protecting them against complete desiccation.

The drastic decline of species richness from 58 in the middle canopy to 24 in the upper layer can be explained by more uniform and extreme thermal and hygric conditions. The greatest spectrum of microhabitats can be found in the middle canopy that also contains the most diverse mycota because (a) open sunny areas lie next to shaded zones and (b) thin twigs exist next to strong, thick branches with fissures and holes in the wood.

Conclusions

Our preliminary results showed that fungi are remarkably diverse in the upper regions of the forest, and that they may play an important role in the complex ecology of the canopy. In tropical forests, fungi probably increase overall plant diversity by causing heavy damage to hosts, which leads to rapid turnover rates. This cannot be explained solely by soils or direct effects of climates This mechanism might also exist as well in temperate forests. We conclude that mycological research should be an essential part of canopy projects in the future.

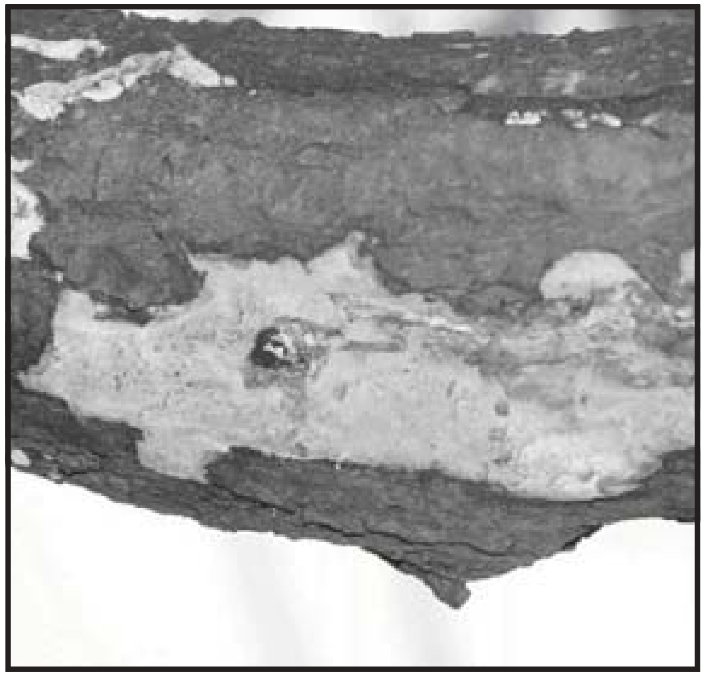

Fig. 2: Fruitbody of a corticioid fungi growing on the lower half of a hanging *Quercus robur* branch.

M. Unterseher, P. Otto & W. Morawetz

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Global Canopy Programme Update

(continued from page 1)

TRAINING COURSES

We are setting up training programmes to build capacity and create new leaders in canopy science, prioritizing those countries with biodiversity hotspots and that lack resources to investigate their own rich treetops. To participate in these courses, visit <<*http://www.globalcanopy.org*>> and click on "training".

BRAZIL TRAINING PROGRAM

The first full, 3-week GCP Canopy Training Course was successfully completed in November, following a pilot in 2002. In partnership with University of Ouro Preto in Minas Gerais state, over 30 Brazilian participants took part including professional climbers, researchers, and students. Climbing equipment, sponsored by Heightec in UK, is now being used by participants from the course. They are now implementing their newly gained skills on four Masters projects and two undergraduate projects. GCP is supporting two more courses in 2004 and 2005 with funds from the UK Foreign & Commonwealth Office Environment Fund.

SABAH TRAINING COURSE

In collaboration with the Institute for Tropical Biology Conservation (ITBC) at the University of Malaysia Sabah, we have developed a 3-year training program, similar to that in Brazil, to run at the Danum Field Centre in North Borneo. It will be jointly managed by ITBC, Yayasin Sabah and the UK's Royal Society. We are now seeking funding for this course, due to start in 2005.

UK TRAINING COURSE

A UK canopy training course has also been developed. The first ten places are already confirmed on the first course in May. The GCP has submitted a proposal to the Ernest Cook Trust to cover the equipment and teaching costs, and has already gained support from Heightec, one of the UK's leading manufacturers of climbing equipment.

IBISCA/BAMBI

With funds from the Rufford Maurice Laing Foundation, the GCP was able to financially support the Investigating the Biodiversity of Soil and Canopy Arthopods (IBISCA) Project in Panama. This is the first comprehensive study of insect alpha and beta diversity in forests from the canopy to the soil using mobile and static access systems. IBISCA is an initiative led by the Smithsonian Tropical Research Institute and the French Canopy Raft Consortium. The first field session was completed over 3 months last autumn and was attended by 45 participants from 15 countries, including 23 professional entomologists, 5 professional botanists, 7 students from the University of Panama and 10 technical staff, as well as professional tree climbers, consultants and photographers. 10,000 samples have been sent to museums worldwide.

This mission was a great success, which can largely be attributed to the enthusiasm and experience of the participants and also for their unfailing support for a team project. Professor E.O. Wilson, one of the world's most eminent biologists, said "I'm delighted to be associated with IBISCA as Patron and thereby to be associated with one of the most exciting field projects in biodiversity and ecology on-going or even imaginable. I was very impressed by all that I saw, by the international character of the team, its inspirational goals, and the unquestionable value of the databases it is producing."

This year, the GCP will be supporting the second phase of IBISCA in May. We are also hoping to combine this work with a field trial of the BAMBi project (BioAcoustic Measurement of Biodiversity) which will for the first time collect sound signatures of the forest, alongside the taxanomic work of the IBISCA project. This will aid in the development of this new revolutionary conservation tool.

CANOPY WALKWAYS

PROJECT MADAGASCAR: CREATING A WORLD CLASS CENTER FOR LEMUR CONSERVATION

In December 2003, the GCP successfully raised $27,000 from the Tubney Charitable Trust for the development of an independent business plan for the construction of a canopy walkway in Ranomafana National Park. This follows a feasibility study in 2003 by our partners in this project, Greenheart Conservation. The just-completed report states that the walkway, plus associated training and conservation activities, will be a viable conservation tool to generate an alternative source of revenue for the local communities surrounding Ranomafana National Park and for the National Park Service, and will aid the conservation of highly endangered and charismatic lemur species. At the same time, the walkway will be an invaluable research tool for scientists to more fully understand lemur behaviour and habitat requirements. This is vital knowledge to support the work to recreate and expand their habitats, and will help to secure their long-term survival at Ranomafana.

UK Walkway

With the Northmoor Trust, in Oxford, one of the UK's leading woodland research organisations, we have begun the development of a plan for a canopy walkway facility in woodland owned by the Trust at Little Whittenham. The Northmoor Trust has successfully raised £1.7M from the UK Heritage Lottery Fund to build a Landscape Evolution Centre. Currently Little Whittenham receives around 150,000 visits a year. The presence of the walkway will greatly enhance visitor experience. The walkway will be built for education purposes both for schools and researchers as well as to inform the general public about the importance of forest canopies. It has been agreed that a proportion of revenues generated by the walkway facility will be given to the Global Canopy Programme. This will provide a much-needed form of sustainable revenue for the GCP secretariat. Currently a proposal is being written up to request funds for a full feasibility study and business plan for the canopy walkway.

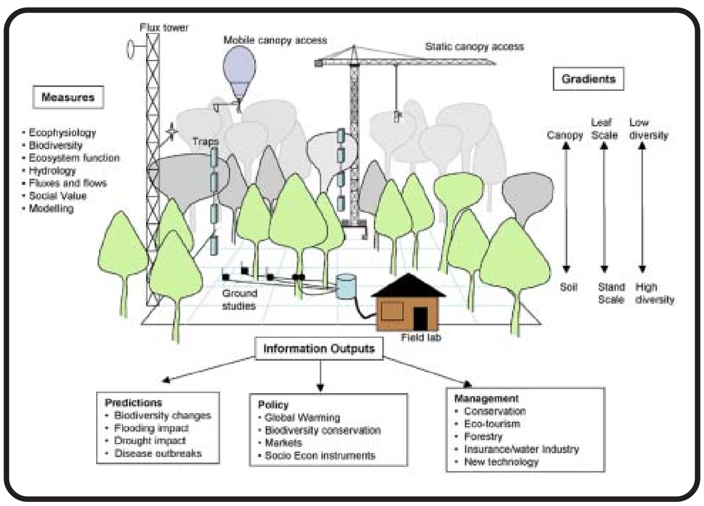


Fig. 1: Model for a GCP 'Whole Forest Observatory'

International Policy

Convention On Biological Diversity

The Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA) of the Convention of Biological Diversity met in Montreal, Canada in November. One of the main topics of discussion at this meeting was the effect of climate change on biodiversity and how the two UN conventions on Biological Diversity and on climate change, will work together. Andrew Mitchell and Katherine Secoy attended this meeting to lobby government bodies, raise awareness, and present a poster that discussed the effects of climate change to biodiversity in forest canopies.

Awareness Raising and Education

Canopy Season at the Eden Project

A meeting was held in January between the UK's Eden Project, Pro-Natura and the Global Canopy Programme to discuss "Canopy Season at the Eden Project". This has grown from the original week-long event and will now run from the weekend of the 11th September, through to the end of October 2004 and in subsequent years. The reason for developing this programme is to raise awareness about canopy science and biodiversity and the importance of the rainforest canopies to our planet.

Following discussions with the GCP and its own in-house creative team, Eden now intends to develop a walkway to allow people access to the treetops inside the remarkable Humid Tropics Biome. Eden is keen to develop a spectacular aerial performance to illustrate life and biodiversity in forest canopies and will host a series of films, debates and presentations about the work of canopy researchers, campaigners and filmmakers on an annual basis. Speakers from across the spectrum of canopy science will be invited to present talks during the season.

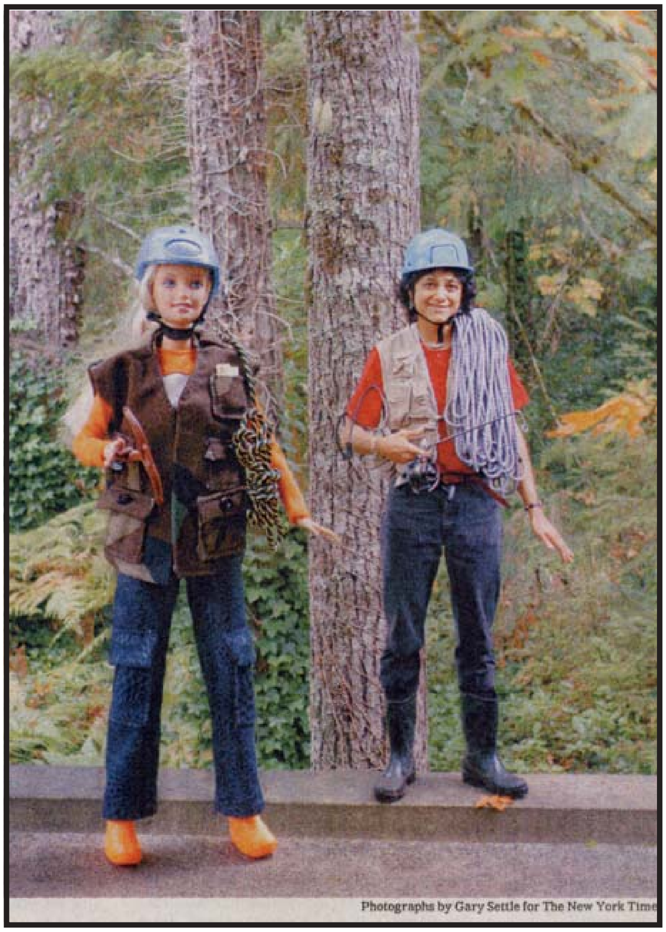
New Canopy Access Technology

GCP has been working with Time Slice Films, the inventors of Flybot and Pro-Natura/Canopy Raft Consortium, the inventors of the Canopy Glider, to display these remarkable vehicles at the launch of the Canopy Season at Eden in September 2004.

Kathernine Secoy, Programme Co-ordinator & Global Canopy Programme; John Krebs Field Station, Department of Zoology, University of Oxford, Wytham, Oxford OX2 8QJ, UK; Phone: +44 (0) 1865 724 222; Fax: +44 (0) 1865 724 555; ‹k.secoy@globalcanopy.org›; ‹‹http://www.globalcanopy.org››.

Treetop Barbie

The International Canopy Network and Dr. Nalini Nadkarni present Treetop Barbie: a rugged yet fashionable Barbie doll who has all the gear she needs to climb in the canopy and uncover its mysteries. The goal of the Treetop Barbie project is to raise consciousness among young girls (and boys!) about the importance of forest canopy organisms and interactions. Treetop Barbie can provide a role model for kids who are interested in alternatives to mainstream culture's Barbie doll image. She can provide encouragement to kids who would like to be field biologists. Additionally, Treetop Barbie can help to raise awareness regarding the importance of forest canopies, both in rainforests and the temperate zone.


Photographs by Gary Settle for The New York Times

This project was reported in the Science section of the New York Times (September 23, 2003), a place where scientific projects from labs and field stations around the world are reported to the general public. Response to the article was astounding, and the story was picked up by newspapers in Hungary, Japan, Australia, and Canada. Orders for the dolls have come from both Barbie aficionados who have little connection to forest conservation, as well as environmentally-minded non-scientists who view it as a way of influencing their children.

Treetop Barbie's field clothes include rough and tumble climbing pants, field vest (complete with pocket holding field notebook), helmet, boots, and the appropriate climbing gear (crossbow for shooting line in the tree and rope and harness). Educational materials will include a letter from Treetop Barbie as well as some information about rainforests, both kid- and adult-oriented. Treetop Barbie's clothes will be sewn locally (Olympia, WA) by Maureen Carter, who has 20 years experience making Barbie clothes.

Funds from the sale of these Barbie clothes will be used for this and other outreach ventures that are geared toward disseminating scientific information about forest canopies. To that end, there are two prices for Treetop Barbie: one that covers production costs only ($50), and one that includes a contribution to educational programs ($100). These contributions are tax-deductible.

If you are interested in Treetop Barbie please contact us at "canopy@evergreen.edu" with "Treetop Barbie" in the subject line, or mail us at International Canopy Network; 2103 Harrison Avenue NW, PMB 612, Olympia, WA 98502 USA.

For more information, check out ‹‹*http://www.evergreen.edu/canopylab/outreach/barbie.html*››.

Treetop Barbie is expected to make her debut this spring, just in time for the field season.

Hannah Anderson, Office Assistant, International Canopy Network; ‹hannah_canopylab@yahoo.com›

Announcements/Meetings

Forest Stewards Guild 2004 Annual Conference and Members' Meeting

Our next annual conference will take place at University of Maine in Orono, Maine on May 19-22, 2004. We will gather in the northern forest of Maine, near Bangor. Maine is the nation's most heavily forested state and its forest-based industries constitute a major economic sector. We will see forestry on a rich array of ownerships – from small family forests to landscape level tracts, publicly and privately owned – including two of the

Guild's model forests. Nationally, the state is in the very forefront of many forestry issues, from liquidation to certification – and we expect discussion of where forestry is headed in this region and beyond. We will also be providing technical workshops. Foresters, forest landowners, forest products harvesters and processors, forest scientists, students, conservationists and policy makers will find something of interest at this event.

Contact: *Forest Stewards Guild, P.O. Box 8309, Santa Fe, NM 87504; Phone: (505) 983-3887 x10; Fax: (505) 986-0798; <info@foreststewardsguild.org>; <<http://www.foreststewardsguild.org>>.*

Joint annual meeting of the American and Canadian Geophysical Unions' (AGU/CGU) session A07: Magnitude and Causes of Decreasing Surface Solar Radiation

Evidence for decreasing surface solar radiation during the second half of the last century has accumulated in the last ten years and has been used to explain the reports of decreasing evaporation. Possible causes of decreased solar radiation at the Earth's surface include: modification of cloud properties, aerosol composition and concentration (both natural and anthropogenic), aerosol - cloud - interactions and surface albedo caused by urbanization, land use changes, snow and ice coverage. As the influence of these radiation changes on plant communities may well be considerable, we encourage those working in these fields to read on.

In the coming AGU/CGU convention to be held in Montreal, Canada, 17-21 May 2004, there will be a special session on this topic. The goal of the session is bringing together a group of researchers from different disciplines to assess the magnitude of observed changes of the surface energy budget, and discuss possible causes and their consequences for the water, carbon and atmospheric cycles. Visit: *<<http://www.agu.org/meetings/sm04/>>.*

Graduate Certificate Program in Sustainable Natural Resources

Oregon State University announces a Graduate-level Certificate Program in Sustainable Natural Resources *<<http://www.cof.orst.edu/SNRcertificate>>* to be offered for the first time during summer term 2004. The Certificate Program offers a curriculum consisting of eleven integrated courses on natural resource sustainability. Eighteen graduate credits and a certificate of completion are awarded upon graduation. The program is taught over the 14-week summer term, beginning June 14 and ending September 17, 2004 and costs $10,000, including tuition and living expenses.

The Graduate Certificate Program in Sustainable Natural Resources is aimed at mid-career employees of government land management agencies, private companies, and non-profit organizations who desire more training to address increasingly complex natural resources problems. Visit: *<<http://www.orst.edu>>.*

A Decade of Research at Wind River

The 10th Annual Wind River Canopy Crane Research Facility Scientific Conference will be held on June 24, 2004 at the Rock Creek Center in Stevenson, Washington, followed by a Forestry Application Session and Field Trip Friday June 25 in the Wind River Basin. The general program is open to the public, and forestry professionals will join scientists in the events.

June 24, Thursday. Rock Creek Center, Stevenson, WA.

9am-1pm. Synthesis papers on some of the major findings from the WRCCRF research program.

2pm-7pm. Poster session on current research with food and non-alcoholic beverages available.

8pm–9:30pm. Evening public program with a major presentation by Jerry Franklin, Director of the WRCCRF and several brief presentations concerning major program accomplishments of scientific interest.

June 25, Friday. USFS Wind River Work Center.

8am-10am. The application of research results to forestry session at the Training Center.

10am-3pm. Field trip in the Wind River Basin.

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

RECENT CITATIONS IN CANOPY SCIENCE

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

Canopy Structure

Binkley, D., J. L. Stape, M. G. Ryan, H. R. Barnard, and J. Fownes. 2002. Age-related decline in forest ecosystem growth: An individual-tree, stand-structure hypothesis. Ecosystems **5**:58-67.

Bond-Lamberty, B., C. Wang, S. T. Gower, and J. Norman. 2002. Leaf area dynamics of a boreal black spruce fire chronosequence. Tree Physiology **22**:993-1001.

Heuret, P., D. Barthelemy, Y. Guedon, X. Coulmier, and J. Tancre. 2002. Synchronization of growth branching and flowering processes in the South American tropical tree *Cecropia obtusa* (Cecropiaceae). American Journal of Botany **89**:1180-1187.

Whitford, K. R. 2002. Hollows in jarrah (*Eucalyptus marginata*) and marri (*Corymbia calophylla*) trees - I. Hollow sizes, tree attributes and ages. Forest Ecology and Management **160**:201-214.

Ecosystem Processes

Arii, K., and M. J. Lechowicz. 2002. The influence of overstory trees and abiotic factors on the sapling community in an old-growth *Fagus-Acer* forest. Ecoscience **9**:386-396.

Catovsky, S., and F. A. Bazzaz. 2002. Feedbacks between canopy composition and seedling regeneration in mixed conifer broad-leaved forests. Oikos **98**:403-420.

Ruesink, J. L., K. E. Hodges, and C. J. Krebs. 2002. Mass-balance analyses of boreal forest population cycles: merging demographic and ecosystem approaches. Ecosystems **5**:138-158.

Forest Management

Busing, R. T., and S. L. Garman. 2002. Promoting old-growth characteristics and long-term wood production in Douglas-fir forests. Forest Ecology and Management **160**:161-175.

Proe, M. F., J. H. Griffiths, and J. Craig. 2002. Effects of spacing, species and coppicing on leaf area, light interception and photosynthesis in short rotation forestry. Biomass & Bioenergy **23**:315-326.

Rieske, L. K., H. H. Housman, and M. A. Arthur. 2002. Effects of prescribed fire on canopy foliar chemistry and suitability for an insect herbivore. Forest Ecology and Management **160**:177-187.

Thiollay, J. M. 2002. Forest ecosystems: threats, sustainable use and conservation. Biodiversity and Conservation **11**:943-946.

Forest Structure

Ibarra-Manriquez, G., and M. Martinez-Ramos. 2002. Landscape variation of liana communities in a neotropical rain forest. Plant Ecology **160**:91-112.

Kant, S. 2002. The marginal cost of structural diversity of mixed uneven-aged hard maple forests. Canadian Journal of Forest Research **32**:616-628.

Weaver, P. L. 2002. A chronology of hurricane induced changes in Puerto Rico's lower montane rain forest. Interciencia **27**:252-258.

Forest-Atmosphere Interactions

Grace, J., F. Berninger, and L. Nagy. 2002. Impacts of climate change on the tree line. Annals of Botany **90**:537-544.

Hilbert, D. W., B. Ostendorf, and M. S. Hopkins. 2001. Sensitivity of tropical forests to climate change in the humid tropics of north Queensland. Austral Ecology **26**:590-603.

Nadkarni, N. M., and R. Solano. 2002. Potential effects of climate change on canopy communities in a tropical cloud forest: an experimental approach. Oecologia **131**:580-586.

Zhang, L. M., J. R. Brook, and R. Vet. 2002. On ozone dry deposition - with emphasis on non-stomatal uptake and wet canopies. Atmospheric Environment **36**:4787-4799.

Invertebrates

Maeto, K., S. Sato, and H. Miyata. 2002. Species diversity of longicorn beetles in humid warm-temperate forests: the impact of forest management practices on old-growth forest species in southwestern Japan. Biodiversity and Conservation **11**:1919-1937.

Ranius, T. 2002. *Osmoderma eremita* as an indicator of species richness of beetles in tree hollows. Biodiversity and Conservation **11**:931-941.

Sessions, L. A., and D. Kelly. 2001. Heterogeneity in vertebrate and invertebrate herbivory and its consequences for New Zealand mistletoes. Austral Ecology **26**:571-581.

Light Transmission

Carter, G. A., and B. A. Spiering. 2002. Optical properties of intact leaves for estimating chlorophyll concentration. Journal of Environmental Quality **31**:1424-1432.

Collet, C., O. Lanter, and M. Pardos. 2002. Effects of canopy opening on the morphology and anatomy of naturally regenerated beech seedlings. Trees Structure and Function **16**:291-298.

Greene, D. F., C. Messier, H. Asselin, and M. J. Fortin. 2002. The effect of light availability and basal area on cone production in *Abies balsamea* and *Picea glauca*. Canadian Journal of Botany **80**:370-377.

Kull, O. 2002. Acclimation of photosynthesis in canopies: models and limitations. Oecologia **133**:267-279.

Micrometerology

Griffith, D. W. T., R. Leuning, O. T. Denmead, and I. M. Jamie. 2002. Air-land exchanges of CO_2, CH_4 and N_2O measured by FTIR spectrometry and micrometeorological techniques. Atmospheric Environment **36**:1833-1842.

Modeling

Buckley, T. N., J. M. Miller, and G. D. Farquhar. 2002. The mathematics of linked optimisation for water and nitrogen use in a canopy. Silva Fennica **36**:639-669.

Suleiman, A., and R. Crago. 2002. Analytical land atmosphere radiometer model (ALARM) applied to a dense canopy. Agricultural and Forest Meteorology **112**:151-159.

Zhang, X. Q., and D. Y. Xu. 2002. Modeling radiation transfer within the canopy of a Chinese fir plantation. Forest Ecology and Management **170**:107-116.

Nutrient Cycling

Enright, N. J. 2001. Nutrient accessions in a mixed conifer-angiosperm forest in northern New Zealand. Austral Ecology **26**:618-629.

Hsu, C. C., F. W. Horng, and C. M. Kuo. 2002. Epiphyte biomass and nutrient capital of a moist subtropical forest in north-eastern Taiwan. Journal of Tropical Ecology **18**:659-670.

Matson, P., K. A. Lohse, and S. J. Hall. 2002. The globalization of nitrogen deposition: Consequences for terrestrial ecosystems. Ambio **31**:113-119.

Vitousek, P. M., S. Hattenschwiler, L. Olander, and S. Allison. 2002. Nitrogen and nature. Ambio **31**:97-101.

Plant Physiology

DeLucia, E. H., K. George, and J. G. Hamilton. 2002. Radiation-use efficiency of a forest exposed to elevated concentrations of atmospheric carbon dioxide. Tree Physiology **22**:1003-1010.

Franco, A. C., and U. Lüttge. 2002. Midday depression in savanna trees: coordinated adjustments in photochemical efficiency, photorespiration, CO_2 assimilation and water use efficiency. Oecologia **131**:356-365.

Li, C. R., Y. H. Liang, and C. S. Hew. 2002. Responses of rubisco and sucrose-metabolizing enzymes to different CO_2 in a C-3 tropical epiphytic orchid *Oncidium Goldiana*. Plant Science **163**:313-320.

Mencuccini, M. 2002. Hydraulic constraints in the functional scaling of trees. Tree Physiology **22**:553-565.

Newell, E. A., S. S. Mulkey, and S. J. Wright. 2002. Seasonal patterns of carbohydrate storage in four tropical tree species. Oecologia **131**:333-342.

Rust, S., and A. Roloff. 2002. Reduced photosynthesis in old oak (*Quercus robur*): the impact of crown and hydraulic architecture. Tree Physiology **22**:597-601.

Plants

Burgaz, A. R., Y. Aharchi, and A. Enabili. 2002. Epiphytic lichens of *Cedrus atlantica* in the Rif mountains (N Morocco). Nova Hedwigia **74**:429-437.

Burnham, R. J. 2002. Dominance, diversity and distribution of lianas in Yasuni, Ecuador: who is on top? Journal of Tropical Ecology **18**:845-864.

Gilbert, O. L. 2002. A transplant operation involving *Lobaria amplissima*; the first twenty years. Lichenologist **34**:267-269.

Kessler, M. 2002. Species richness and ecophysiological types among Bolivian bromeliad communities. Biodiversity and Conservation **11**:987-1010.

Norton, D. A., J. J. Ladley, and A. D. Sparrow. 2002. Host provenance effects on germination and establishment of two New Zealand mistletoes (Loranthaceae). Functional Ecology **16**:657-663.

Remote Sensing

Haara, A., and S. Nevalainen. 2002. Detection of dead or defoliated spruces using digital aerial data. Forest Ecology and Management **160**:97-107.

Lefsky, M. A., W. B. Cohen, D. J. Harding, G. G. Parker, S. A. Acker, and S. T. Gower. 2002. Lidar remote sensing of above-ground biomass in three biomes. Global Ecology and Biogeography **11**:393-399.

Weiss, M., F. Baret, M. Leroy, O. Hautecoeur, C. Bacour, L. Prevot, and N. Bruguier. 2002. Validation of neural net techniques to estimate canopy biophysical variables from remote sensing data. Agronomie **22**:547-553.

Wittmann, F., D. Anhuf, and W. J. Junk. 2002. Tree species distribution and community structure of central Amazonian varzea forests by remote-sensing techniques. Journal of Tropical Ecology **18**:805-820.

Research Equipment and Methodology

Arrabal, R., F. Amancio, L. A. Carneiro, L. J. Neves, and E. Mansur. 2002. Micropropagation of endangered endemic Brazilian bromeliad *Cryptanthus sinuosus* (L.B. Smith) for in vitro preservation. Biodiversity and Conservation **11**:1081-1089.

Pepin, S., and C. Korner. 2002. Web-FACE: a new canopy free-air CO_2 enrichment system for tall trees in mature forests. Oecologia **133**:1-9.

Tree Architecture

Valladares, F., J. B. Skillman, and R. W. Pearcy. 2002. Convergence in light capture efficiencies among tropical forest understory plants with contrasting crown architectures: a case of morphological compensation. American Journal of Botany **89**:1275-1284.

Vertebrates

Eberhard, J. R. 2002. Cavity adoption and the evolution of coloniality in cavity-nesting birds. Condor **104**:240-247.

Ganzhorn, J. U. 2002. Distribution of a folivorous lemur in relation to seasonally varying food resources: integrating quantitative and qualitative aspects of food characteristics. Oecologia **131**:427-435.

Hansson, L. 2002. Mammal movements and foraging at remnant woodlands inside coniferous forest landscapes. Forest Ecology and Management **160**:109-114.

Humphries, M. M., D. W. Thomas, C. L. Hall, J. R. Speakman, and D. L. Kramer. 2002. The energetics of autumn mast hoarding in eastern chipmunks. Oecologia **133**:30-37.

Koperski, P. 2002. Factors determining diversity in diet composition: multivariate analysis of a guild of epiphytic predators. Archiv Für Hydrobiologie **155**:291-314.

Raphael, M. G., D. E. Mack, and B. A. Cooper. 2002. Landscape-scale relationships between abundance of Marbled Murrelets and distribution of nesting habitat. Condor **104**:331-342.

Miscellaneous

Ackerman, J. D. 2002. Diffusivity in a marine macrophyte canopy: Implications for submarine pollination and dispersal. American Journal of Botany **89**:1119-1127.

Gilbert, G. S., A. Ferrer, and J. Carranza. 2002. Polypore fungal diversity and host density in a moist tropical forest. Biodiversity and Conservation **11**:947-957.

Osono, T. 2002. Phyllosphere fungi on leaf litter of *Fagus crenata*: occurrence, colonization, and succession. Canadian Journal of Botany **80**:460-469.

Pennings, S. C., and R. M. Callaway. 2002. Parasitic plants: parallels and contrasts with herbivores. Oecologia **131**:479-489.

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