

WHAT'S UP?

THE NEWSLETTER OF THE INTERNATIONAL CANOPY NETWORK

NALINI NADKARNI, EDITOR

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Canopy season at Eden

The Eden Project, Bodelva,
Cornwall, PL24 2SG, UK
13th September to 31st October
2004



In collaboration with the Global Canopy Programme, Pro-Natura International, and the International Canopy Network, 'Exploring Life on a Different Level' at Eden will give the scientific canopy community an opportunity to connect directly with colleagues and the public.

The mission of The Eden Project is to promote the understanding and responsible management of the vital relationship between plants, people and resources leading to a sustainable future for all. The objectives of the event are to: 1) excite and raise awareness about the importance of canopy science and biodiversity locally, nationally and globally; 2) initiate and engage our visitors (1.4 million annually) in debate and discussion about canopy biodiversity and the importance of research in the canopy; 3) illustrate canopy science methods and technological innovations; and 4) demonstrate that science is fun, adventurous, and explorative.

'Exploring Life on a Different Level' will run for seven weeks, with the first two weeks focusing on canopy scientists, the next three weeks on education with school groups, and the remaining two weeks with visitors. It will include a rolling program of events, stories from canopy scientists, debates and interactive projects, and raising awareness of the science and biodiversity of forest canopies worldwide. The latest canopy access research methods will be displayed, including the Tower Crane, IKOS, Canopy Bubble, Canopy Raft, Flybot, and Canopy Glider.

Everyone who attends will have access to all events. We will feature a "Big Canopy Conversation" on 16-18 September (with an invitation-only VIP Gala Dinner on Friday), in which the canopy community will come together to exchange information and ideas

You are welcome to participate. Submit your interest (giving a talk or workshop, and/or attending) to: *Don Murray, Tropics Curator; The Eden Project, Bodelva, Cornwall, PL24 2SG, UK; <dmurray@edenproject.com>; <<http://www.edenproject.com>>*.

CORRECTION

In the cover story of *What's Up?* 10:2, we featured an article written by Andrew Mitchell that discussed the progress of the many projects being administered by the Global Canopy Programme (GCP), including the Whole Forest Observatory. We included a photo of the proposed "Canopy Glider". The placement of this image may have indicated that it was being developed by the GCP, while in fact it is being developed by Pro-natura and the Canopy Consortium in France as part of the Whole Forest Observatory. We apologize for any confusion.

Arthropods from the canopy of *Attalea phalerata* Mart. (Arecaceae) in the Pantanal of Mato Grosso, Brazil

HYPOTHESIS

In studying of the community structure of canopy arthropods, the flood pulse influences the density, richness, and trophic guilds of terrestrial arthropods in canopies of the palm *Attalea phalerata* Mart. (Arecaceae).

METHODS

Pantanal of Mato Grosso is annually flooded up to 1.5 m between December and March. Six palms of *Attalea phalerata* (Arecaceae) near Poconé (16°15'S, 56°22'W) were sprayed/fogged in a monodominant stand ("acurizal") with synthetic pyrethrum during the terrestrial phase (low water season: November/December 1999) and the aquatic phase (high

RESULTS

During the terrestrial phase, 238.7 ± 80.6 arthropods/m² were collected. Biomass was calculated biomass as 0.39 ± 0.04 mg/m². Coleoptera (27.4%) and Formicidae (19.0%) dominated (Fig. 1). Adult beetles represented 48 families and 326 morphospecies. Tenebrionidae (22.9%) and Curculionidae (22.0%) were the most dominant families. Curculionidae (44 spp.) and Staphylinidae (40 spp.) had the highest number of morphospecies.

During the aquatic phase, 642.8 ± 259.7 arthropods/m² were collected, and biomass was 0.18 ± 0.03 mg/m². Acari (40.0%), and Coleoptera (12.0%) dominated (Fig. 2). Adult beetles represented 48 families and 467 morphospecies. Endomychidae (22.9%) and Nitidulidae (15.8%) were the dominant families. Staphylinidae (89 spp.) and Curculionidae (56 spp.) had the highest number of morphospecies.

The aquatic phase represented a 2.6 times higher arthropod abundance and a greater diversity of adult beetles (141 more morphospecies) compared to the terrestrial phase. However, arthropod biomass was 2.2 times lower during the aquatic phase, indicating a higher amount of smaller-sized animals (e.g., Acari, Coleoptera:

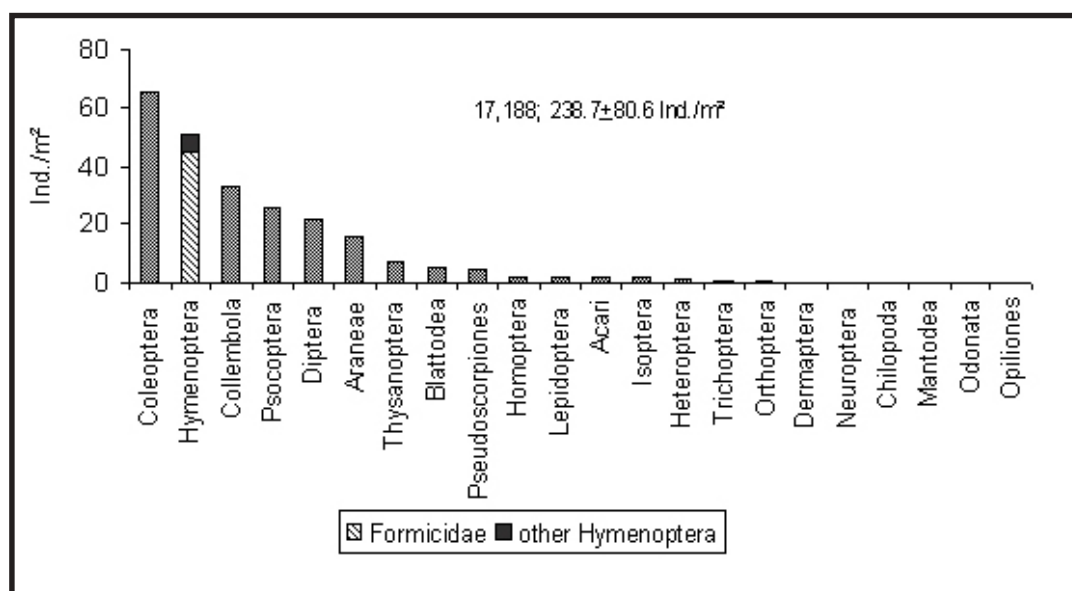


Fig. 1 – Arthropods obtained from six canopies of *Attalea phalerata* Mart. (Arecaceae) during the terrestrial phase in the Pantanal of Poconé, Mato Grosso, Brazil.

water season: February 2001). Falling arthropods were intercepted by 12-17 nylon funnels (diameter 1 m²) with plastic bottles (containing alcohol) and positioned under the canopy following Erwin (1989) and Adis *et al.* (1998). Arthropods were identified to order, and the Coleoptera were identified to family and morphospecies. Arthropods from three palm canopies were subsequently used for biomass determination.

Ptiliidae) and a different structure of its canopy community. This is mirrored in the trophic guilds of Coleoptera, with fungivores being dominant during the aquatic phase (27.7% versus 14.6%) and herbivores during the terrestrial phase (37.5% versus 24.9%). Differences were attributed to a restricted availability of habitats and their resources when wide areas are flooded.

CONCLUSIONS

The data indicate that seasonality influences the community structure (abundance, richness, and trophic guilds) of terrestrial arthropods in the canopies of *Attalea phalerata* in the Pantanal of Mato Grosso, Brazil. The palm may be considered a keystone species for terrestrial arthropods in Pantanal floodplains because it is used both as a temporal refuge and a location for reproduction during flooding (e.g., by Acari, Isopoda, and polydesmidan Diplopoda) by different taxa.

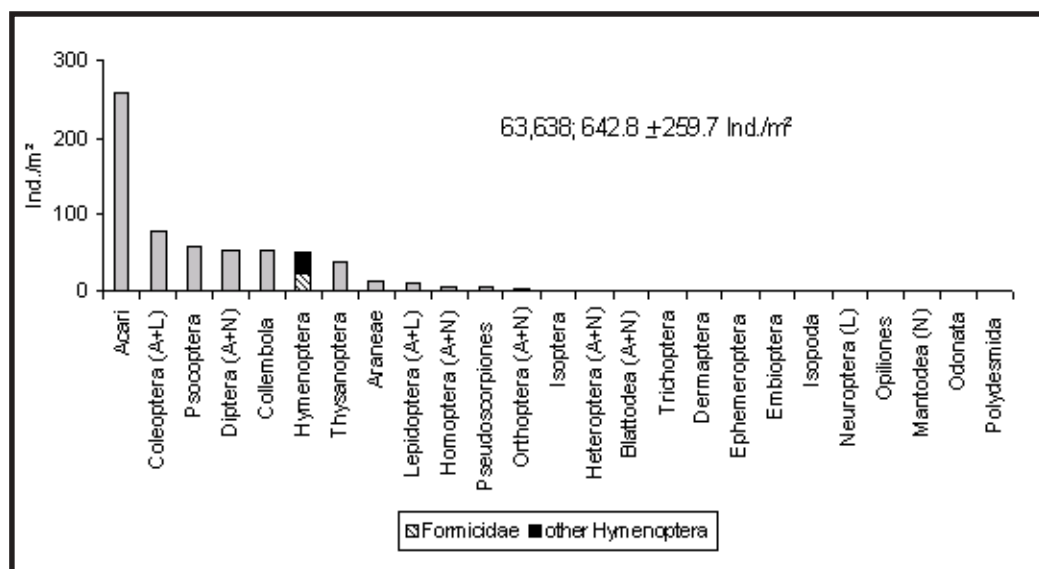


Fig. 2- Arthropods obtained from six canopies of *Attalea phalerata* Mart. (Arecaceae) during the aquatic phase in the Pantanal of Poconé, Mato Grosso, Brazil (A = adults; L = larvae; N = nymphs).

LITERATURE CITED

- Adis, J., Y. Basset, A. Floren, P. Hammond & E. Linsenmair. 1998. Canopy fogging of an overstorey tree – recommendations for standardization. *Ecotropica* 4:93-97.
- Erwin, T. L. 1989. Canopy arthropod biodiversity: a chronology of sampling techniques and results. *Revista Peruana de Entomologia* 32:71-77.
- Leandro Dênis Battirola¹, Geane Brizolla dos Santos¹, Marinêz Isaac Marques², and Joachim Adis³

- 1- Universidade Federal do Paraná, Programa de Pós-Graduação em Ciências Biológicas – Concentração em Entomologia, Cx. Postal 19020, 81531-980 Curitiba-PR, Brasil. Bolsista CAPES; <ldbattirola@uol.com.br>.
- 2- Universidade Federal de Mato Grosso, Av. Fernando Correa da Costa, s/n, Coxipó, 78060-900, Cuiabá-MT, Brasil; <m.marque@terra.com.br>.
- 3- Max-Planck-Institute for Limnology, Tropical Ecology Working Group. Postfach 165, D-24302 Plön, Alemanha; <adis@mpil-ploen.mpg.de>.

Revised ICAN website

ICAN is pleased to announce the launch of its newly revised website. The site features a new look as well as the addition of pop-up menus, making the site faster to navigate. Additionally, the meetings section of the site is now grouped into current and past meetings, which allows users to keep up with canopy-related meetings more easily.

The site is still divided into eight categories: General information about ICAN, Research, Education, Conservation, Global Canopy Program, Public Outreach, Canopy Access, and Meetings.

Site highlights include:

- Tree Top Talks, a flash-animated conservation video
- Classic Canopy Citations, featuring 50 important citations from 12 categories
- Extensive links to other resources and sites

- Citations database (with over 4700 citations), scientific glossary, and image gallery
- Back issues of “What’s Up?” in PDF format

The site also features the Curriculum Vitae of numerous researchers and educators in the field of canopy studies. As a benefit of membership, ICAN members can have their CVs posted in this section by e-mailing them to <canopy@evergreen.edu>.

Visit the site at <<<http://www.evergreen.edu/ican>>>.

Also check out some of our other revised and updated sites: **Forest Canopy Lab at the Evergreen State College** <<<http://www.evergreen.edu/canopylab>>>; **National Geographic Branching Out project** <<<http://www.geocities.com/canopylab>>>; **Research Ambassador project** <<<http://www.ResearchAmbassador.com>>>.

An open letter to canopy researchers from a canopy interpreter

“The greatest wonder is that we can see these trees and not wonder more.”

—Ralph Waldo Emerson, from a conversation with John Muir.

No one can refute the human attraction to trees. At the Cincinnati Nature Center, we capitalize on this innate attraction through a unique opportunity for education. Cincinnati Nature Center, a private non-profit whose mission is “to inspire passion for nature and promote environmentally responsible choices through experience and education,” offers guided natural history “vertical hikes”. These experiences allow participants to view the natural world in a new way. Tree climbing programs use the double rope technique (DRT) of recreational tree climbing as taught by Tree Climbing USA and Tree Climbers International. Individual programs have themes that incorporate natural history topics ranging from katydids to tree frogs to the full moon.



The center has been offering climbs since September 2003, after the appearance of an article on the links between humans and trees over evolutionary time in a Cincinnati Nature Center newsletter. Today, many people have a deep attachment to trees. But the usefulness and beauty of trees are insufficient explanations for humankind’s attachment; therefore, one must seek an internal, biological explanation.¹ In 1897, J.O. Quantz, proposed that “through the period of a few thousand generations, during which the surest means of safety from enemies was flight into the trees, there would gradually grow up in the human race an instinctive feeling for trees as natural protectors.”² Even though humans have not directly relied on trees for our survival for millennia, the residual emotional attraction to trees remains with humans today.

TWO VENUES

The goal of Cincinnati Nature Center’s public tree climbing programs are to provide memorable experiences that connect participants to the natural world. These experiences contribute to the formation of a strong environmental ethic.

The Cincinnati Nature Center has partnered with the Glen Este School for Scientific Studies, a high school that has an unusually progressive approach. Students in this school stay with the same teachers for four years, developing a sense of community. The curriculum is integrated such that science, math, English and other courses are taught together. Teachers at the school seek opportunities to integrate “real” science into the curriculum. Students from the school found three previously unidentified species of microscopic wasps in the Great Smoky Mountains National Park as a part of the All Taxa Biodiversity Conference in 2002 (see *What’s Up?* 7:1). The Glen Este School for Scientific

Studies has expressed interest in local canopy science/education opportunities.

BLENDING PERSPECTIVES

One critical aspect of our tree climbs is the change in perspective that participants experience as they ascend into one of the two red oak trees used for climbing. Some participants, upon touching down on the ground, have said, “that was the most amazing thing I have ever done.” From the professional perspective of environmental interpretation, tree climbing can serve as a vector to relay many natural science topics and lead into general environmental or sustainability-related issues. According to the National Association for Interpretation, “In-

terpretation is a communication process that forges emotional and intellectual connections between the interests of the audience and the inherent meanings in the resource.” The resources, in this case, are the trees/forest, canopy processes and importance of the canopy. Interpretation seeks to reveal deeper meaning and to provoke visitors to think intently about the presented topic.

From the perspective of experiential education, there are consequences for our behavior, both personal and collective, and a wide range of possible metaphors to link the experience of a tree climb to much greater significance. Cincinnati Nature Center is blending these perspectives into a unique program that will no doubt expand and draw increasing media attention.

THE FUTURE

Through collaboration between Cincinnati Nature Center and the Glen Este School for Scientific Studies, we hope to establish a canopy walkway to enhance the science education for students. The canopy access system will be applicable for guided use with the general public as well as primary students. We hope to encourage visitors to further develop a sense of place in southwest Ohio’s temperate forest.

A REQUEST

One of the things that attracted me to ICAN was its focus on education outreach. Although I am comfortable with the “how” of environmental interpretation, I seek input regarding the “what” that should be interpreted with regard to canopy science. With that in mind, I welcome your responses to the following questions:

What are the most significant elements of canopy biology that should be relayed to the general public?

What arthropod or small mammal traps and atmospheric or hydrologic sampling apparatus could be adapted for educational use in our context?

What research could be replicated by high school students from the Glen Este School for Scientific Studies? Is there current research these students could assist with?

Any input is greatly appreciated. Please respond to me at the address below.



RELATED READINGS

¹ Sommer, Robert. “Dendro-Psychoses: People & Trees.” *Arborist News*. (10)1. Feb. 2001.

² Quantz, J.O. “Dendro-Psychoses.” *American Journal of Psychology*. 9:449-506. 1897.

Kellert, S.R., and E.O. Wilson (Editors). *The Biophilia Hypothesis*. Island Press, Washington, D.C. 1993.

Neumann, J.A. “A View From the Oak.” *Newsleaf: A Publication for Members of the Cincinnati Nature Center*. (37) 4: 10-11. Sept-Nov. 2003.

Jason Neumann, Assistant Education Director, Cincinnati Nature Center, Long Branch Farm and Trails, 6926 Gaynor Road, Goshen, OH 45122. <jneumann@cincynature.org.>

New ICAN tee-shirts!

Spread the word about forest canopies in your neighborhood or workplace with your very own ICAN tee-shirt!

ICAN is excited to offer a new line of tee-shirts. All shirts are made with 100% organic cotton, and feature a silhouette by Bob Van Pelt (author of *Forest Giants of the Pacific Coast*) on the front and ICAN logo on the sleeve. Shirts come in “natural” color, and are available in four sizes: small, medium, large, and extra-large. An image of the shirt is on the ICAN website: <<<http://www.evergreen.edu/ican>>>.

Shirts are \$20 for residents of US/Canada/Mexico and \$25 elsewhere (shipping & handling included).

To order, send check, money order, or Visa/MC # and expiration date to: ICAN; 2103 Harrison Avenue NW, PMB 612, Olympia, WA 98502; Phone: (360) 866-6788; <canopy@evergreen.edu>.



GLOBAL CANOPY PROGRAMME UPDATE

Global Canopy Programme Basic Canopy Access Training Course (BCAT)

Over the past year, the Global Canopy Programme (GCP) has been developing a canopy-access training course following the strict safety standards of UK Health and Safety law, with the aim of providing new safety protocols for gaining access to the canopy. To our knowledge, this is the first system to use ground-based rescue techniques as a central principle for increasing safety in tropical research.

Many rope-access systems exist, each with their own strengths and limitations. However, many of the techniques used by canopy researchers today are not compliant with UK Health and Safety Law. Increased concern about litigation means that opening the canopy to more people is increasingly difficult. To counter these issues, the GCP has pioneered a new access system based on guidance from the rope access industry trade association and the Health and Safety Executive. The BCAT course is the first to allow people with no climbing experience to become proficient in canopy access while conforming to some of the strictest regulations in the world for working at height.

This course has been developed with the assistance of Andy Barrell, a renowned arborist and canopy access specialist. Andy has been involved in filmmaking with the BBC natural history unit for many years, and has developed the BCAT techniques within a industry setting. The techniques and sys-

tems used have been rigorously field-tested in rainforests, and have proven to be safe and efficient.

After consulting with arborists and industrial access specialists, we tailored the course to conform to British safety standards, which require provision for rescue. BCAT uses a ground-based rescue system (GBRS) that enables a trained ground crew to lower a casualty to the ground via their climbing lines, thus negating the need for a potentially dangerous aerial rescue. Every part of the course has been designed to provide the highest degree of safety possible. Course partici-

pants are made aware of the consequences of poor decisions based on overconfidence and underestimation of the dangers of canopy work. All rope work is based on industry guidelines and assessed under those same standards.

BCAT has been designed as a holistic course that treats the actual climbing as only one component of a network of procedures that must be followed to provide a safe working environment for research. As well as learning double rope climbing techniques, course participants

learn how to plan a canopy research expedition, identify hazards at the site, carry out a canopy risk assessment, select appropriate anchors, insert lines, rig ropes, and set up the GBRS. We also teach aerial rescue, with participants learning how to ascend lines to rescue a casualty from the canopy. On



Big shot line installation

the final day of the course, attendees are given the opportunity to test their skills by carrying out canopy experiments such as small-mammal trapping. At the end of the course, participants are tested and, if successful, are awarded the BCAT certificate.

The first course took place in Oxford from 14-17 May 2004, in Wytham Woods, Oxford, with all 12 participants gaining the BCAT certificate. Everyone in the course provided positive feedback, with nearly everyone ranking the experience as 'excellent'. All of the participants were from UK universities and had interest in the conservation of forest canopies. Most are now using



Aerial rescue practice

their training in the field in other countries, such as Britain, Borneo, and Sri Lanka.

The GCP thanks Andy Barrell (Access Applications) for developing and teaching the course, Remote Access International for training support, and Heightec Ltd. for providing most of the climbing equipment at a substantial discount. We are grateful to the Ernest Cook Trust and the Cecil Pilkington Foundation for support.

If you are interested in future BCAT courses, contact John Pike at the GCP jp@globalcanopy.org.

The Towed Balloon Apparatus

In the last two decades, canopy access has developed in multiple directions, with both self-supporting and mobile access techniques. However, problems of access have made statistically sound sampling difficult. Nearly all researchers admit to some degree of bias in their choice of trees; they must either be of the appropriate size and architecture to climb safely, or occur directly below a canopy crane or canopy sled. Studies are still restricted to a finite and potentially biased set of trees without replication of stands. Furthermore, few studies or sites can be directly and effectively compared (Nadkarni 2002). Techniques that have both mobile and self-supporting characteristics are needed to expand our reach, making previously unexplored areas accessible. To date, self-supporting canopy access techniques are not mobile and mobile ones are not self-supporting. Here, I discuss how proven technology for tree seed harvesting may close this gap.

A crane, for example, makes an individual tree almost entirely accessible, especially the upper and outer crown. It requires no athletic or technical skills, only financial resources from the researcher. However, access is limited to the reach of the crane jib. Rope techniques, on the other hand, are highly mobile, but they can only support a researcher from above. It is nearly impossible to reach spots not located beneath weight-bearing branches. Therefore, the architecture and size of many trees severely limit rope access to the upper and outer crown. Except for the use of airships, mobile techniques rely on the tree for support, thus prohibiting free movement within the individual tree.

For the requirements of tree-seed harvesting, the specialized German manufacturer Ballonbau Wörner, creator of the COPAS Balloon, has developed a simple and functional device: the Towed Balloon Apparatus (TBA). The TBA consists of three components: 1) a gas balloon, 9 m in diameter, 2) a basket for the occupant, and 3) a small vehicle, the crawler.

The balloon is roughly 280 m³ in volume and uses hydrogen. Because helium is 8-10 times more expensive, its usage is reserved for exceptional cases. Hydrogen is frequently used by balloonists and is safe when handled properly.

The crawler is a mini-caterpillar with tracks made of rubber, measuring 1.2 x 1.6 m. It carries an electric winch with 100 m of steel cable, a generator, and a platform, upon which the basket is situated. The cable passes through the basket via an opening in the bottom. Basket, balloon, and winch work in a manner similar to a captive balloon, with the crawler as its base.

To operate the TBA, the balloon is deployed from its "dormant" position on the ground to a position above basket and crawler. With the basket's suspension ("blocstop") unlocked, the cable is released from the winch. The balloon needs a 10 m wide opening in the canopy to ascend. Next, the crawler (with the basket) drives along the ground, while the operator maneuvers the cable through the gaps between the crowns. Underbrush and small branches are no hindrance, and "crown shyness" helps. When a desired location is reached, the sus-

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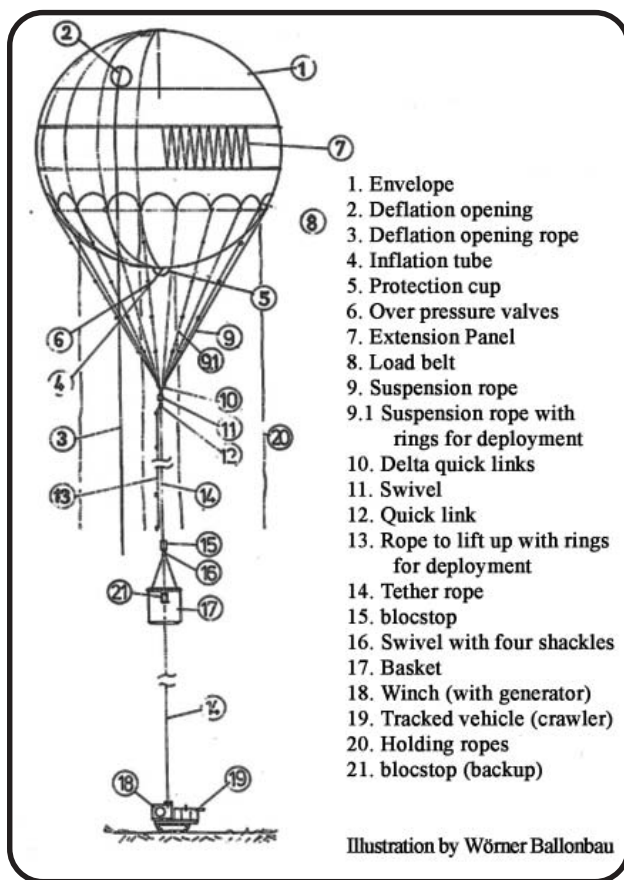
pension mechanism of the basket is locked. If the cable is further released from the winch, the basket and its passenger are carried upward along with the cable. The winch allows the height to be precisely adjusted, and the crawler determines the horizontal position. Thus, the basket can reach any position within a three-dimensional space and within the tree, including its center.

The ascent of the balloon is limited to 100 m, which allows for a working height in a closed canopy layer of up to 50 m. Using the winch, the basket can immediately descend and come to rest on the crawler, without needing to consider the balloon. It constantly remains at a safe height above the trees to work as the winch's counterpart. Its buoyancy greatly exceeds the burden of the cable, basket, and passenger. Thus, the cable remains constantly taut. For longer breaks, the balloon is steered through an opening in the canopy and positioned near the crawler, to protect it from weather changes. From this "standby" position, it can immediately re-ascend. To berth the balloon on the ground and to rig anew takes approximately 20 minutes. The system has been approved by the LBA (German Civil Aviation Office). Restrictions of this technology, as with all aerostats, are due to speed and gustiness of wind. The upper limit is around 10 knots.

I used a TBA with my crew in the forests of the Rhine valley of Germany. Our task was to collect the fruits of poplars for commercial use. The apparatus was flexible and effective. In 2 months of use, the balloon did not require deflation.

For canopy exploration, the TBA is a method that allows both free movements within the individual tree as well as transportability to most research sites. A trailer suffices for transportation over long distances and is inexpensive. The apparatus can reach island locations on all-terrain vehicles or boats. Delicate instruments can be installed and traps de-

ployed easily and quickly. The basket can be maneuvered through both horizontal and vertical profiles accurately. It is fast enough to allow near-simultaneous sampling, both within and between crowns. Steering occurs from the ground, so the passenger does not need those skills. All functions are also possible at night, when there is usually less wind.



The TBA is particularly useful to collect replicates of canopy samples. Studies on the reproduction of trees, dead standing trees, savannah-like forest formations, and the "supra canopy zone" (Sutton 2001) would likely benefit from this technology.

There are at least two limitations of the TBA. First, wind speeds follow patterns related to daylight. Because of these patterns, wind sensitivity of the TBA may create problems for time-sensitive studies. Second, in forests with multiple strata it probably would be difficult to maneuver the cable.

The construction of a new system costs ca 60,000 ● (approximately \$72,000 US), transportation trailer not included. Additional expenses include a 2-3 person crew, technical maintenance, legal permits, and balloon gas. Filling the 280 m³ balloon costs between \$280-450, plus transportation of two pallets of cylinders. During operation, the loss through diffusion accounts for 15 m³ per week.

The TBA offers new dimensions in canopy research and promises many new scientific insights from the high frontier.

For further information, contact: Hannes Hoffmann, University of Bochum; <TBA.Hoffmann@web.de>.

Literature cited:

Nadkarni, N. 2002. In: The Global Canopy Handbook, p. 113.
Sutton, S.L. 2001. Alice grows up: canopy science in transition from wonderland to reality. *Plant Ecology* 153:19.

ANNOUNCEMENTS/MEETINGS

**4th International Canopy Conference:
Canopy ecology—tropical versus temperate forests
10–17 July 2005, Leipzig, Germany**

Preliminary call and questionnaire

The 4th International Canopy Conference will bring together experts in forest canopy biology from all over the world in order to spread and share research results and ideas and establish and strengthen collaborations.

Large permanent canopy access facilities function in six temperate forests and five tropical rainforests (including the COPAS system in French Guyana), so it is appropriate to compare the ecology and functioning of whole forests, including canopies, in both zones.

The conference will be organised by the University of Leipzig and the UFZ Centre for Environmental Research Leipzig-Halle. There will be morning and evening plenary talks, and up to three parallel sessions on different topics such as canopy structure, epiphytes, effects of climate change, plant physiology, phenology, and pollination.

We encourage colleagues from non-US or non-European countries to apply early and to look for travel grants. To fill out a planning-related questionnaire (due by 30 June 2004), go to the ICAN website (<http://www.evergreen.edu/ican>) and click on “Meetings-4th International Canopy Conference”.

For information on scientific matters, contact: *Wilfried Morawetz; University of Leipzig, Institute for Botany, Systematic Botany, Johannisallee 21–23, 04103 Leipzig, Germany; Phone: +49 341 / 97385-90; Fax: +49 341 / 97385-49; <morawetz@uni-leipzig.de>*

**Treeclimbing, Trapeze, Ropes, Rigging, and
Environmental Education (TTRREE)**

Interested in learning about tree climbing accidents that have occurred and how to prevent them? TTRREE, an organization dedicated to promoting safe and environmentally-responsible climbing, has documented 18 major climb accidents, as well as how these deaths and injuries could have been prevented. We've started to design climb-site survey standards, and are seeking funds to enable us to research climb site impacts. To suggest funding sources, submit data or stories, or learn more about our initial survey protocols, project plans, and funding needs, visit: <http://academic.evergreen.edu/r/rimde28/ttree.htm>

More information is also available on the ICAN website <http://www.evergreen.edu/ican>, under “Access”.

WEBSITES

Forest Health Website

The Department of Natural Resources (DNR) has just launched its new forest health website. The Forest Health Program provides technical assistance on tree and forest health care for a variety of public and private landowners.

Go to <http://www.dnr.wa.gov/>, then scroll down to “featured sites” in the middle of the page and click on “Forest Health”.

JOBS

Fellowships in Tropical Biology

The Smithsonian Tropical Research Institute (STRI), a division of the Smithsonian Institution located in the Republic of Panama, offers fellowships for undergraduate, predoctoral, and postdoctoral research in the areas represented by its scientific staff. Disciplines include ecology, anthropology, paleontology, evolutionary biology, molecular phylogenetics, biogeography, animal behavior, soil sciences and physiology of tropical plants and animals. Awards are based upon merit, without regard to race, color, religion, sex, national origin, age or condition of handicap of the applicant.

For information: *STRI/Office of Education, Unit 0948, APO AA 34002-0948, from US or Apartado 2072, Balboa, Panama from Latin America, <fellows@tivoli.si.edu>; <http://stri.org>*.

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 September, 2004. 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. The deadline for submissions is August 15, 2004. For further information or to send contributions, please contact the ICAN office:

David Franklin, Outreach Coordinator/Editorial Assistant; 2103 Harrison Avenue NW, PMB 612, Olympia, WA 98502; (360) 866-6788; <canopy@evergreen.edu>

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

Frak, E., X. LeRoux, P. Millard, B. Adam, E. Dreyer, C. Escuit, H. Sinoquet, M. Vandame, and C. Varlet-Grancher. 2002. Spatial distribution of leaf nitrogen and photosynthetic capacity within the foliage of individual trees: disentangling the effects of local light quality, leaf irradiance, and transpiration. *Journal of Experimental Botany* 53:2207-2216.

ECOSYSTEM PROCESSES

DeFries, R. S., L. Bounoua, and G. J. Collatz. 2002. Human modification of the landscape and surface climate in the next fifty years. *Global Change Biology* 8:438-458.

Gobeil, J. F., and M. A. Villard. 2002. Permeability of three boreal forest landscape types to bird movements as determined from experimental translocations. *Oikos* 98:447-458.

FOREST MANAGEMENT

Reid, S., C. Cornelius, O. Barbosa, C. Meynard, C. Silva-Garcia, and P. A. Marquet. 2002. Conservation of temperate forest birds in Chile: implications from the study of an isolated forest relict. *Biodiversity and Conservation* 11:1975-1990.

FOREST-ATMOSPHERE INTERACTIONS

Baumgardner, R. E., T. F. Lavery, C. M. Rogers, and S. S. Isil. 2002. Estimates of the atmospheric deposition of sulfur and nitrogen species: Clean Air Status and Trends Network, 1990-2000. *Environmental Science & Technology* 36:2614-2629.

Iroume, A., and A. Huber. 2002. Comparison of interception losses in a broadleaved native forest and a *Pseudotsuga menziesii* (Douglas-fir) plantation in the Andes Mountains of southern Chile. *Hydrological Processes* 16:2347-2361.

Loppi, S., G. Destito, S. A. Pirintsos, and V. DeDominicis. 2002. Temporal variation of air pollution in a geothermal area of central Italy: assessment by the biodiversity of epiphytic lichens. *Israel Journal of Plant Sciences* 50:45-50.

INVERTEBRATES

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