Accessing Forest Canopies

Margaret Lowman, PhD, discusses a new tool for orchid conservation

E. O. WILSON CALLS IT "THE LAST frontier" of biological research on the planet. Forest canopies have long eluded scientists because of the logistical difficulties of reaching tree crowns and the subsequent challenges of sampling once one gets up there. Only in the last decade have field biologists begun extensive exploration of this unknown world of plants, insects, birds, mammals and their interactions. These strides are attributed to the development of several innovative and creative techniques that facilitate ascent into tree crowns.

There are a number of exciting reasons that canopy access has become a priority for many scientists. First, as rainforests continue to dwindle, the urgency of surveying the biodiversity in tree crowns challenges some researchers. There are reputedly many orchids, as well as other plants and countless invertebrates, that choose the environment of the treetops, and perhaps have escaped detection. Second, canopy processes are essential to life on our planet — canopy organisms are integral to the maintenance of rainforest ecosystems, and the canopy is a major site of productivity in terms of photosynthesis and turnover of carbon dioxide. And third, many researchers admit to simple curiosity to explore this previously inaccessible region of forests. For example, how many orchids remain undetected in the upper regions of tree crowns, and what is their distribution and abundance?

Biologists in the 19th and 20th centuries traditionally based their ideas about forests on observations made at ground level. These ground-based perceptions are summarized in a comment by Alfred R. Wallace from 1878:

"Overhead, at a height, perhaps, of a hundred feet, is an almost unbroken canopy of foliage formed by the meeting together of these great trees and their interlacing branches; and this canopy is usually so dense that but an indistinct glimmer of the sky is to be seen, and even the intense tropical sunlight only penetrates to the ground subdued and broken up into scattered fragments ... it is a world in which man seems an intruder, and where he feels overwhelmed."

Ideas about forest canopies had changed very little for 100 years until the 1970s, when biologists first adapted technical mountain-climbing hardware for ascending tall trees. Termed SRT (single-rope techniques), this versatile method enables scientists to reach the mid-canopy with ease, and hang suspended to make observations of pollinators or to count epiphytes. But rope techniques have several limitations: they are not conducive to collaborative work (because one rope holds only one person) and they are not useful for reaching the uppermost canopy because branches there are too weak to support the climber and the ropes.

There are several other methods that allow simple vertical ascent of tree trunks. The tree bicycle and use of climbing spikes facilitate vertical access up one trunk. They both require caution in use, however, because of their potential destructive impact on bark and epiphytes. The traditional ladder method is adequate for access to low trees and understory, and is relatively inexpensive and easy to use. At Selby Gardens, researchers use ladders to

Opposite: Possibly the world's largest treehouse, a complex walkway and platform site for canopy research at Blue Creek, Belize in Central America.

OPPOSITE: D. LOWMAN

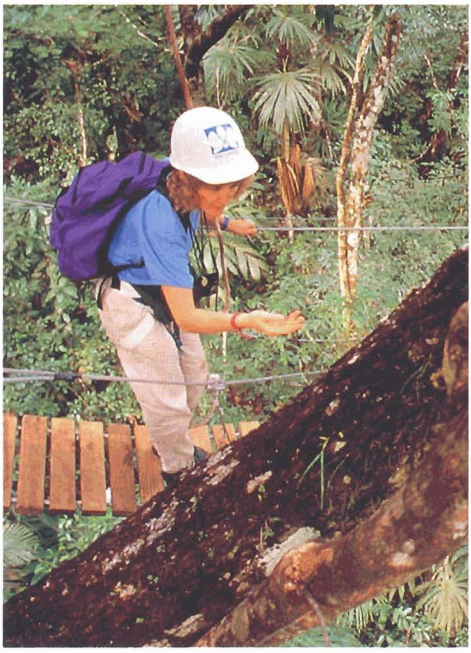
LUCINDA LACHELIN

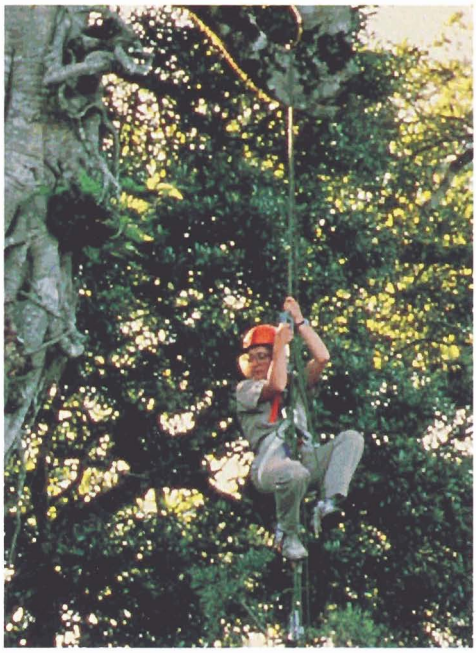
Opposite: Cymbidium Saint Helier (Mavourneen x New Dimension) brightens the spring scene with its sprays of long-lasting flowers.
Above: Tiered benches permit an interesting display of orchids, including the cheerful *Miltoniopsis* hybrids shown here.

oculata, Stanhopea tigrina and *Stanhopea wardii*. Although lasting for just a few days, the flowers emit a pungent spicy scent that cannot be ignored. Brassias, vandas, coelogynes and dendrobiums in baskets and on cork rafts also introduce color high in the house.

Orchids in The Singapore Airline Orchid House are changed daily. Each visit reveals new treasures certain to spark interest among all who enjoy nature. □

Lucinda Lachelin *was in a three-year course in rural resources and their management before becoming a horticultural student at Wisley for one year. Afterward, she was employed in the glasshouse department and then became involved with the orchid collection there three and a half years ago. She is now orchid grower and the Orchid Committee Secretary of the Royal Horticultural Society. Walking, painting and traveling are among her hobbies.* **John Watkins** *started growing orchids at the age of 14 in his parents' London home. In 1981, he became the Eric Young Orchid Scholar at Wisley. After five years working and studying horticulture in Scotland, John returned to Wisley as supervisor of the glasshouses in 1987. Four years later he was responsible for the design and construction of The Singapore Airlines Orchid House. John is now a senior lecturer in horticulture at Hadlew College in Kent. His hobbies include photography and visiting gardens. In 1993, he authored* The Glasshouse Garden *as part of the new RHS book series with Conran Octo-pus. • The Royal Horticultural Society, Wisley, Woking, Surrey GU23 6QB England.*





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study native Florida epiphytes in oak-palm hammocks and in coastal cedar hammocks. A device that was pioneered in Malaysia, called the canopy boom, offers similar access to a single researcher into the understory or mid-canopy regions; but the boom gives an additional advantage over ladders and ropes of some horizontal motion.

For those who do not feel comfortable dangling from ropes, the use of towers or scaffolding represents a more permanent means of canopy access. Towers are stable for long-term observations, but are limited in that only one or two trees are within reach of one tower.

An improvement on the tower design is the construction of platforms and suspension bridges that can be linked to provide a network of access to an entire stand of trees. Recently, I have been engaged in collaborative research projects in both temperate and tropical forests using this mode of access. One walkway system, built in southern Belize, is affectionately called "the world's largest treehouse" and was the site of 61 live television broadcasts for the Jason Project in science education, funded by National Geographic and the National Science Foundation. From a height of 100 feet, I conducted research on epiphytes and canopy ecology "in view of" hundreds of thousands of students via live satellite linkage. Our "treehouse," with five platforms and connecting bridges, held up to four scientists, four student assistants, and a television production crew of eight, plus equipment.

Of a more colorful and innovative nature, the Radeau des Cimes (or canopy raft) has been developed and used successfully by a French scientific team led by Francis Hallé of Institute de Botanique. The 65-foot-square inflatable raft forms a platform on top of the forest canopy, and is utilized as a base for research on the trees around its perimeter. A dirigible (or balloon) moves the raft to new positions throughout the jungle, where research can be conducted on the atmosphere just above the canopy.

During 1991, I was fortunate to participate as a canopy biologist on the Radeau

Opposite left: The author searching for *Pleurothallis hondurensis* from a canopy walkway at the height of 120 feet in southern Belize.
Opposite right: In Queensland, Australia, the author employs the SRT (single-rope technique) in a *Ficus watkinsiana* tree.
Above: Aerial view of the *Radeau des Cimes* operation — the dirigible pulling a portable sled for canopy studies in the treetops of lowland tropical rainforest, Cameroon, Africa.

des Cimes expedition to Cameroon, Africa, where we pioneered a new canopy technique called the sled. This small 16 x 16-foot triangular miniraft was towed across the canopy by the dirigible, similar to a boat with a trawling apparatus on the sea. It facilitated collection of canopy leaves, flowers, vines and epiphytes, as well as their pollinators and herbivores.

Another relatively new technique involves construction cranes. A 120-foot-long crane was recently erected in Panama dry forest by researchers from the Smithsonian Tropical Research Institute, and provides access into any tree canopy within the radius of the crane. Working from the crane bucket, researchers can descend into treetops as well as hover just above the uppermost canopy.

It is nonetheless important to recognize that not all canopy researchers require such complex methods to study the treetops. Some studies can be conducted from the ground. Binoculars remain a faithful tool for any researchers looking upward, such as for observations of epiphyte distribution or flowering. Samples of fallen plants can also give important clues as to what exists in the crowns without directly climbing. Fish-eye photographs, video cameras and observation blinds can also serve to gather information about life in the treetops.

Now that the logistic problems of access into forest canopies have been solved, the bigger challenges lie ahead. Biologists who work in this region must design useful sampling techniques. Canopy studies range from measuring sessile organisms (orchids, sedentary insects, trees) to mobile organisms (flying insects, birds, mammals) to canopy processes (studies of the interactions of organisms up in the treetops). All of these studies require sampling designs that are effective at heights,

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function in an air substrate and can be carried out when dangling from a rope or some otherwise awkward position. Many interesting questions remain unanswered:

- What are the dynamics of orchid germination and survival in natural canopy conditions?
- How many invertebrates live in bromeliads at different canopy heights?

How do birds use epiphytes?

- Do vines serve as highways for insects in canopies?
- What is the diversity of orchids in a tree crown in a tropical wet forest?

The pressures of human populations and exploitation of the tropics give an added incentive for researchers to undertake studies in tropical-forest canopies. The next 10 years will be critical, to attempt to classify the biodiversity and ecology of rainforest canopies before habitat fragmentation takes its toll. Hopefully, canopy-access techniques will provide valuable information about orchids and other organisms that will facilitate the implementation of better conservation schemes. □

Above and opposite: View of the forest floor (above) 90 feet below the Amazon Rainforest Canopy Walkway at the Amazon Biosphere Reserve in Peru (opposite).

Margaret Lowman, PhD, *earned a master's in ecology at Aberdeen University (Scotland) and a doctorate in botany at the University of Sydney, where she pioneered canopy research in old-world subtropical and tropical forests. She has worked in forest canopies worldwide, and utilized almost every known technique of access into tree crowns. She is now director of research and curator of the herbarium at Marie Selby Botanical Gardens, where she continues an active research career in the ecology of plants and insects in forest canopies. She is co-chairing the First International Forest Canopy Symposium at Selby Gardens in November 1994. She is also editing a book on canopy biology, due in early 1995 (Academic Press), and writing a volume on the natural history of forest canopies, scheduled for 1995 (Yale Press). • Marie Selby Botanical Gardens, 811 South Palm Avenue, Sarasota, Florida 34236.*