Using construction cranes to reach above towering treetops, scientists are achieving a better overview of forest ecology and how trees contribute to global climate change

Sky-High Experiments

Plant ecologist Christian Körner of the University of Basel, Switzerland, goes to work by soaring into the sky on a construction crane. He and his colleagues squeeze into a four-person cage and, in 30 seconds, are carried up 30 meters. The crane operator guides the gondola to the end of the 45-meter-long boom and slowly lowers it, leaving Körner and his colleagues dangling just above the 30-meter-tall treetops of the Swiss forest they're studying.

Körner's first ride more than a decade ago was an eyeopener. "The canopy was not the green carpet we thought, but highly structured, with peaks, gullies, canyons, and deep gorges among some crowns," he recalls.

Once a novelty, cranes have become essential for sorting out forest dynamics, say ecologists. Most of a tree's photosynthesis occurs in its canopy—the upper leaves, twigs, and branches—and 40% of the world's terrestrial species live there. From their lofty perches on cranes, researchers have been counting species and studying leaf and tree physiology for more than a decade. More are now turning their attention to global change. Körner, for example, wants to know how forests capture greenhouse gases. On page 1360, he and his colleagues report findings from the first phase of a long-term experiment looking at carbon dioxide's effects in established forests. "[This study] is our first real glimpse of how mature forests might respond to increasing concentration of atmospheric carbon dioxide," says Kurt Pregitzer, an ecologist at Michigan Technological University in Houghton.

Körner is among several hundred ecologists, plant physiologists, taxonomists, and conservationists who have moved their studies off the forest floor to the more productive upper layers. These researchers work at about a dozen crane sites scattered around the world (see map, p. 1315). But if they can cobble together a relatively modest amount of money, these researchers have even more ambitious plans. In an effort called the Global Canopy Program (GCP), Körner and his colleagues are pushing to double the number of research cranes and train more students, scientists, community leaders, and educators in their use.

Lift off. Körner (*inset*) and his team do their work dangling 30 meters above the ground.

From the top

Linking the earth and sky, canopies harvest energy from the sun and create organic matter. They provide moist and dry spots, as well as warm and cold pockets, making possible a huge diversity of forest fauna. Canopies also play a role in global climate change, although researchers have yet to pin down exactly how. For example, trees suck in carbon dioxide for use during photosynthesis, whereas microbes release it by degrading fallen canopy leaves.

Although forest researchers are often willing to don climbing equipment to scale tree trunks or build walkways that sway among the branches, these strategies afford only a partial view of the canopy. The tops of trees either can't be reached from below or can't support the weight of people. In contrast, cranes offer a top-down perspective that forest researchers have wanted. In the past 15 years, "cranes have become the symbol of canopy research," says Kamal Bawa, head of the Ashoka Trust for Research in Ecology and the Environment in Bangalore, India.

In 1992, Alan Smith of the Smithsonian Tropical Research Institute (STRI) in Panama was the first to get this bird's-eye view of a canopy, using a 40-meter-high crane set up among the trees in a Panama City park. The vista was breathtaking and the view of the greenery below, stupendous. By swinging the crane's boom around in a circle and shuttling the gondola along its length and lowering the cage to different heights, researchers could finally get the big picture of a canopy.

A second crane was set up in 1997 in a different spot in Panama, a site where some 85 ecologists and taxonomists are now using a range of techniques designed to pin down the number and identities of arthropod species in the canopy. Established in 2003, the arthropod project now has 400,000 specimens and 1080 species in its archives. As it continues, researchers expect to find many thousands more specimens and large numbers of new species. Only with this many samples "can the many patterns of diversity, community organization, and functional roles of individual taxa [in the canopy] be understood," says forest ecologist Andreas Floren of the University of Würzburg, Germany.

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