UNIVERSITY OF WASHINGTON School of Forest Resources

Wind River Canopy Crane Research Facility

The Wind River Canopy Crane Research Facility is a forest ecosystem observatory, the first of its kind in North America. It is cooperatively managed by University of Washington School of Forest Resources, USDA Forest Service Pacific Northwest Research Station, and Gifford Pinchot National Forest.

The canopy of a forest functions as an immense sky-comb or atmospheric scavenger capturing nutrients, carbon dioxide, and light, and feeding back moisture, complex biological compounds, and oxygen.

The total surface area of the leaves and branches in the world's forest canopy is about equal to the total surface of the earth. A single old-growth Douglas-fir tree with 60 to 70 million individual needles may have more than an acre of surface area. Entire old-growth ecosystems have an average of ten or more layers of leaves and needles over every square inch of the forest floor—much more than a rotation-age plantation forest. Such large leaf areas result from the rough, "canyon-peak" topography of the old-growth canopies, or the "rumple" factor as one scientist portrayed it.

This immense and complex canopy structure is the site of many important ecological functions. The great diversity of environmental conditions provides high levels of biological diversity. A myriad of invertebrates, mosses, lichens, fungi, and vertebrates make their homes (sometimes their only homes) and livings in the multitude of old-growth canopy niches.

Critical ecological functions—such as photosynthesis, transpiration, and interception of fog, rain, and snow—occur in the canopy. Canopy architecture, for example, is an important factor influencing the intensity of rain-on-snow flood events in forested regions, thus affecting the amount and timing of storm runoff. Likewise, reproduction in the form of cones, seeds, flowers, and fruits is a critical function of the canopy. To understand these and other processes, scientists need access to sites 200 feet or more above ground. This is exactly what the Wind River Canopy Crane Research Facility provides.

photo by Jerry F. Franklin

The crane is located in the Thornton T. Munger Research Natural Area of the Gifford Pinchot National Forest in Skamania County Washington, 65 miles northeast of Portland, Oregon. At 1,200 feet elevation, the site exemplifies the old-growth Douglas-fir and western hemlock forests that originally covered much of western Washington's Cascade Range.

The crane itself is 250 feet tall (about 22 stories) and has a load jib that is 279 feet long. The gondola can rise 225 feet into the air or be lowered in almost any location in a 550-foot circle, giving researchers access to nearly 365 cubic acres of old-growth canopy.

Forest Canopy Research

A wide range of individual and collaborative research projects takes place at the Wind River Canopy Crane Facility. Abstracts for all research projects can be found on the Web site: http://depts.washington.edu/wrccrf.

♦Canopy Architecture

Literally the shape of the forest (the spatial arrangement of trees, crowns, branches, leaves, cones, etc.), canopy architecture shapes ecological processes ranging from atmospheric interactions to wildlife habitat. Researchers at the crane facility are measuring these variables from the smallest components such as needle morphology to large-scale phenomena like crown form. A key question is how does canopy architecture affect gas and energy exchange with the atmosphere? In many ways, wind behaves like water. When it flows across a uniform surface (such as a second-growth canopy), the exchange of gases and other materials is less than when it flows over a complex surface. The peaks and valleys of an old-growth canopy create eddies between the wind and the forest. Researchers are working to quantify this effect.

♦Climate Change

Increasing CO_2 levels in the atmosphere are a main contributor to global climate change, and forests store carbon. But to what degree are old-growth forests CO_2 sinks? What is the balance between uptake, storage, and release of carbon? To find answers, researchers use the crane to measure both the total carbon stored on the site as well as the exchange of carbon between the atmosphere and the stand.

♦Water and Light

The crane makes measuring light environments in forests possible. Using light meters as they move through the canopy, scientists have defined functional light zones. These zones affect the vertical distribution of lichens and mosses, which in turn influence the availability of nitrogen and other nutrients. Other researchers are studying how the canopy affects precipitation quantity and quality as it moves from the canopy to the forest floor, as well as how much water a large, old-growth tree uses.

♦Canopy Wildlife

Researchers are using the crane to investigate how birds and bats use the forest canopy. For example, do they focus their activity in individual layers of the canopy? Initial observations indicate that foliage insectivores are most abundant in the mid-canopy zone—a zone often absent in young forests. By learning more about the structures required by these and other animals, foresters will have a better idea of what to preserve or recreate when managing forest ecosystems.

♦Insects and Disease

The crane makes it possible to study the ecology of a parasite of western hemlock, dwarf mistletoe. For example, how is it transmitted between parts of the forest, and how does it affect the health of the forest? Studies focusing on canopy insects range from an investigation of the silver-spotted tiger moth that defoliates patches of tree crowns to canopy-dwelling predatory insects such as spiders that protect the forest from insect damage.

♦Canopy Design

Much of the basic research on canopy structure and its influence on ecological processes and biological diversity will help design forest canopies in managed forest stands. The objective is to design formats which will produce high levels of ecological services at the same time as they efficiently produce wood products.

♦Education Program

Although research is the primary function of the canopy crane, a secondary objective is to serve as a facility and facilitator for education. Activities have included cooperative learning programs with high school biology courses, Earthwatch Student Challenge Awards, educational lifts, guided walking tours, K-12 classroom visits, interpretive displays, and TV, newspaper, magazine, and book features.

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