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A TOWER CRANE FOR CANOPY RESEARCH IN TEMPERATE CONIFEROUS RAINFORESTS, WASHINGTON STATE, USA

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The Olympic Natural Resources Center is developing forest canopy research observatories in temperate coniferous rainforests on the western Olympic Peninsula, Washington State (FIGURE 1). The aim is to provide researchers with access to the entire three dimensional space of forest canopies for a broad range of scientific investigations. The Olympic Natural Resources Center has a particular interest in improving our understanding of the structure, function, and biodiversity of forest canopies and applying this information to forest management, including structural designs for managed forests. A tower crane will be the centerpiece of the research facilities, and will be located in a large old-growth or late successional forest (FIGURE 2). An additional canopy observatory is planned for a managed second-growth forest using an alternative access system.

THE TOWER CRANE AS CANOPY OBSERVATORY

The Smithsonian Tropical Research Institute has shown that the tower crane is a powerful tool for access to the forest canopy—especially the difficult to access outer forest canopy (Parker *et al.* 1992). Our crane will be located in an old-growth forest. The jib will extend above the tallest trees in the stand (FIGURE 2), and a modified gondola will be attached to the hook to provide access for researchers and their equipment to nearly any location in the three-dimensional canopy space. Tree boles and bases of large branches, however, will be more efficiently accessed by

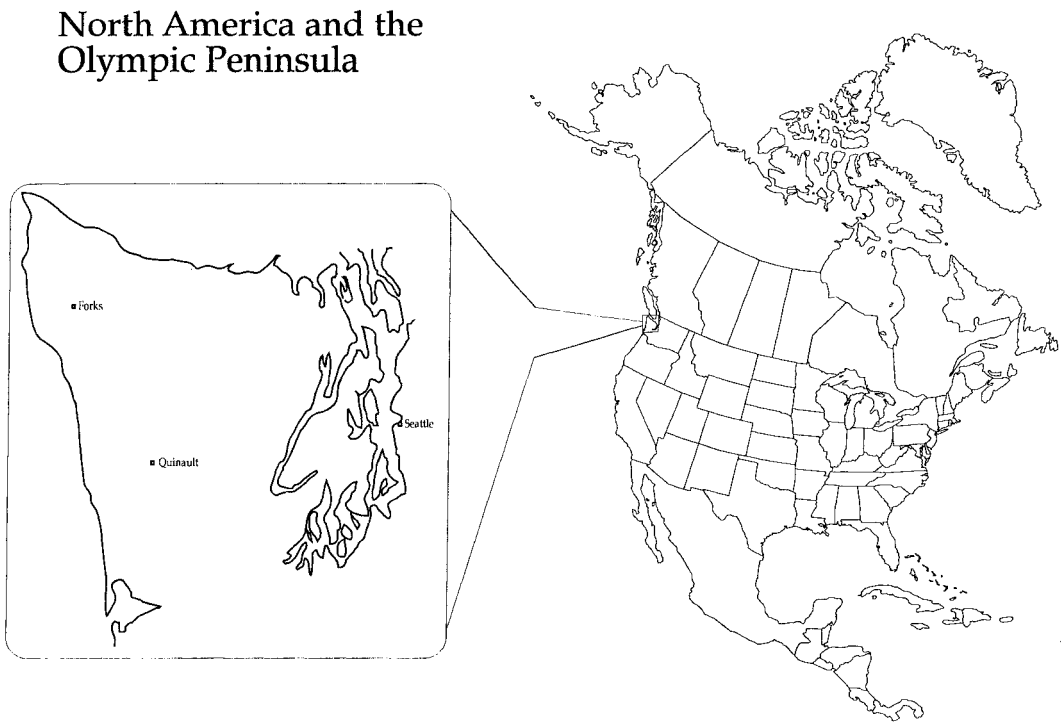

FIGURE 1. North America and the Olympic Peninsula, Washington State, USA. Canopy research observatories are planned for the western Olympic Peninsula near Quinalt and Forks. The crane will be near Quinalt. Illustration courtesy of Ken Bible.

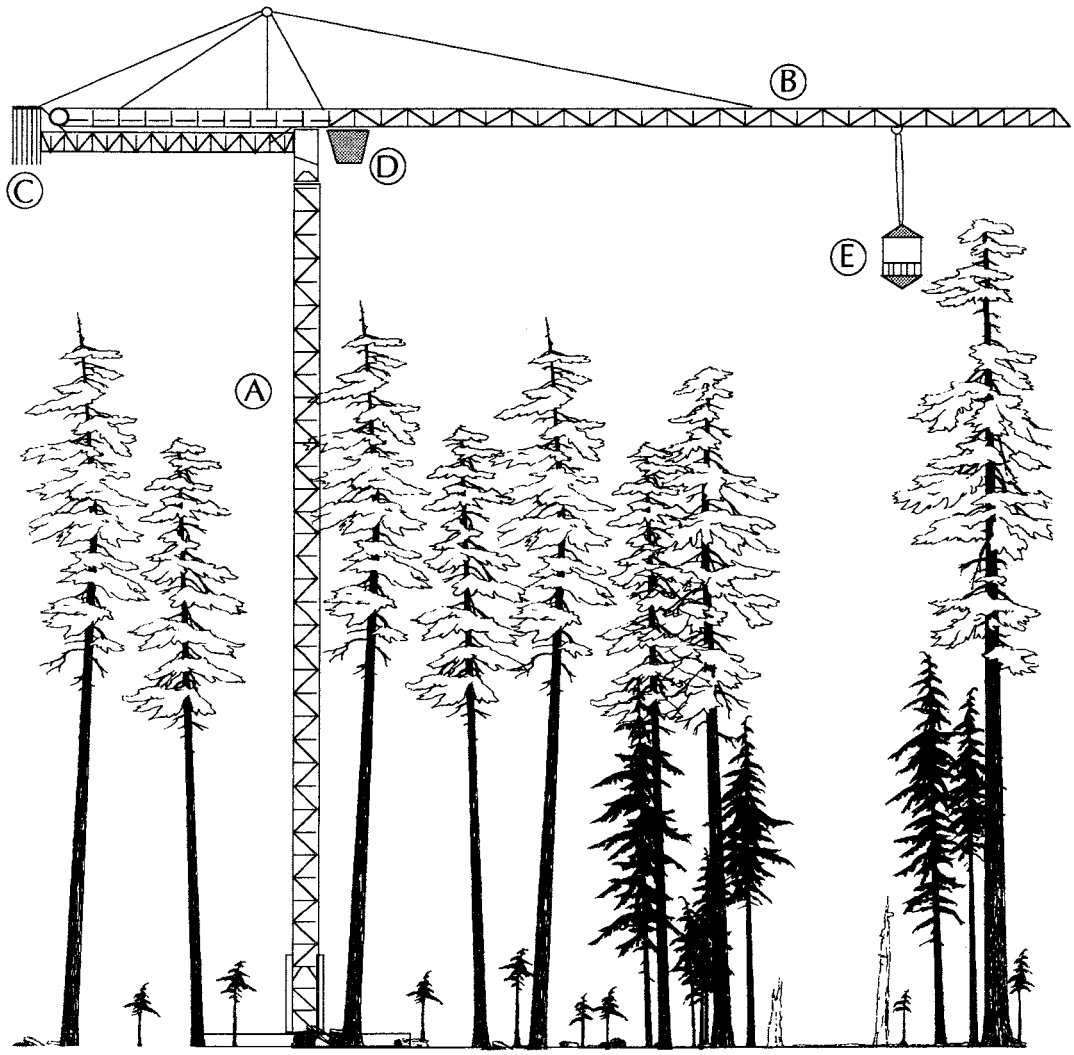

FIGURE 2. Forest Canopy Crane: A) tower, B) load jib, C) counter-balance jib, D) operators' cab, E) gondola. Tree illustrations are by Robert Van Pelt.

climbing apparatus (Tucker & Powell 1991). We expect the crane to have a 70 to 80 m long jib, which will access nearly two ha of forest. The anticipated height of the tower under the jib is 85 m. The tower crane is a semi-permanent facility which can operate 24 hours a day, 365 days a year, except for times when wind speed exceeds 35 mph.

INSTALLATION OF THE TOWER CRANE

Minimizing disturbance to the study stand during crane installation is critical and several approaches have been discussed. Construction of a concrete foundation 10 m × 10 m will cause the greatest disturbance to the study site. Installation of the tower and jib sections could be accomplished by: 1) helicopter only; 2) helicopter installation with a light road, 4 m wide, to the base for transporting materials; 3) semi-improved road, 4 m wide, for access by a small mobile crane which would place the jib on the tower followed by self-erection of the remaining tower sections; and 4) improved road, 10 m wide, for access by a mobile crane with an additional 15 m × 30 m landing for the mobile crane to assemble the tower crane. The latter two scenarios require the jib to be assembled within the study forest before it is lifted onto the tower, which may cause additional disturbance. The

preferred approaches are #2 or #3. Removal of some suppressed or intermediate-sized trees may be required; codominant or dominant trees, however, will not be removed. Installation is planned for summer 1993.

The Olympic Natural Resources Center Forest Canopy Research Program

The old-growth forest canopy observatory, with the canopy crane as its centerpiece, will facilitate detailed studies of forest canopy structure, function, and biodiversity. Aspects of forest structure targeted for study include: detailed mapping of all the structural elements of live and dead wood in the canopy, distribution of foliage, snags, and canopy gaps. Topography of the upper forest canopy (sensu Parker *et al.* 1992) will also be described. The dynamics of these elements will then be monitored by repeated measurement over long time periods. Functional attributes of the forest canopy to be studied include: canopy-atmosphere interactions, canopy contribution and influence to ecosystem nutrient cycles, canopy interaction with forest hydrology, and forest canopy influences on wildlife habitat. Three-dimensional analysis of interior canopy space as related to vertebrate habitat is also planned. In addition, biotic inventories will be initiated and links drawn between the occurrence and abundance of biotic elements to structural elements of the forest canopy. Further work is planned describing microclimate and gaseous gradients from forest floor to above the tallest trees.

Additional research of interest to the Olympic Natural Resources Center canopy research program includes: population dynamics of forest insect pests, aerobiology, dynamics of decay in live trees, ecology of dwarf mistletoes in western hemlock, physiology of various aged leaves and various aged branches, scaling from individual leaf to entire tree and forest stand, and validation of models which utilize carbon uptake, photosynthesis and respiration data.

The Olympic Natural Resources Center is joining the Smithsonian Tropical Research Institute (Panama) and the Smithsonian Environmental Resource Center (Maryland, USA) to create the International Network of Forest Canopy Research Observatories. Membership in the network involves a commitment to the aforementioned work in forest structure, documentation of litter dynamics, establishment of a meteorological station, description of soils, and descriptions of the vertical light environment (see Parker *et al.* this issue).

The Olympic Natural Resources Center also has the broader objective of comparative analysis of canopies in older forests with those in managed/second-growth forests. To accomplish this, we plan to establish another research facility in a managed landscape. This site may utilize access techniques such as canopy walkways, platforms, and/or skyline cables. One purpose is to compare and contrast the more simply structured but productive young-growth forests of the region to the structurally complex and taller old-growth forests. The objective is to design elements of natural forest structure and function into young stands managed for wood production. A potential application of such work is management of endangered wildlife species of the area such as marbled murrelets or spotted owls. The comparisons will also be useful for incorporating naturally occurring processes which increase productivity, landscape values, and biodiversity.

Conclusion

Inaccessibility has drastically limited canopy research in temperate forests. The large tower crane is an important new tool in expanding scientific research in northwestern forest ecosystems. The Olympic Natural Resources Center will use the tower crane as the centerpiece of a larger research program which seeks better understanding of forest ecosystems and the application of this information in solving forest management problems on the northern pacific coast of North America.

Acknowledgments

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