Tree Establishment in Canopy Openings in Mature Douglas-fir Forests

Andrew N. Gray, Department of Forest Science, Oregon State University, Corvallis, OR 97331; Thomas A. Spies, Pacific Northwest Research Station, U.S. Department of Agriculture, Forest Service, 3200 Jefferson Way, Corvallis, OR 97331

Biological diversity in coastal Douglas-fir forests is strongly associated with forest age and the arrangement of older forests on the landscape. Many plant and animal species first appear late in succession as these forests develop the multi-layered and patchy canopies characteristic of old growth. It is presently unknown whether this influx of species is in response to a general decline in the dominance of the large Douglas-fir (*Pseudotsuga menziesii*), or to discrete openings in the forest canopy (termed "canopy gaps") caused by the death of large trees. The answer is important for maintaining ecological diversity in managed forests and reserves.

The objective of our research is to determine how the establishment of tree seedlings is affected by the environmental and vegetative changes caused by canopy gaps in Douglas-fir forests. The abundance of light and moisture available for young seedlings varies due to the size of the canopy gap as well as the position within a gap. For example, large gaps have more light and soil moisture than small gaps, and the northern edges of gaps receive more light than the southern edges. Patterns of resource abundance are further

modified by the density of ground-level vegetation and the presence of wood, litter, or mineral soil as a seedbed. We hypothesize that tree species will respond differentially to the gradients in above- and below-ground resources in gaps. Canopy gaps have been shown to be critical to the community dynamics of the temperate deciduous and tropical forests where gaps have been studied (Pickett and White 1985).

Our tree seedling establishment study has been set up in openings that were cut as part of a controlled, long-term experiment on ecosystem response to gap formation (Spies et al. 1990). Gaps of four sizes (10–50 m in diameter) and uncut control areas were established in the summer and fall of 1990 in two old-growth and two mature stands located at the Wind River Experimental Forest in southern Washington and the H. J. Andrews Experimental Forest in central Oregon.

The tree seedling establishment study will monitor the emergence and survival of Douglas-fir, western hemlock (*Tsuga heterophylla*), and Pacific silver fir (*Abies amabilis*) seedlings from seed planted at north, center, and south positions within a range of gap sizes and on log, litter, and mineral soil seedbeds. Shrub competition also is being studied through use of artificially shaded microsites. Seedling survival will be correlated with measurements of available light, moisture, and temperature. The results of these controlled experiments will also be compared with seedling establishment from natural seed fall. We expect to determine many of the environmental requirements for natural regeneration of several common Pacific Northwest tree species in mature forests. This information will help us understand the links between small disturbances and biological diversity. It may also assist forest managers in reforestation of small selection cuts, or the promotion of plant and animal diversity in mature forests.

References

Pickett, S. T. A., and P. S. White. 1985. Natural disturbance and patch dynamics: An introduction. Pp. 3–13 *in* S. T. A. Pickett and P. S. White, eds. *The ecology of natural disturbance and patch dynamics.* New York, NY: Academic Press.

Spies, T. A., K. A. Vogt, J. F. Franklin, and R. Van Pelt. 1990. Above- and below-ground response of coniferous ecosystems to tree-fall gaps. *Northwest Environmental Journal* 6(2):435–436.