Forest Opening Influence on Seedling Establishment and Growth

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Overview:

- Early seral species can regenerate and grow under a wide range of different canopy openings
- At 55 percent canopy opening, western white pine has competitive advantage, growing faster than western hemlock. At 92 percent opening, western white pine is free to grow, meaning it will likely become the dominant tree in the canopy. Optimum growth begins at 8 acres.
- One entry will require units that contain minimum opening sizes that favor 92% canopy opening (≥ 1 acre, ≤ 40 ft2/acre ≤ 20 Trees/acre).
- The number of sunflecks that affect a seedling has a negative relationship with growth. Group trees to decrease number of sunflecks.

Summary:

Management problem: For centuries, western white pine (*Pinus monticola*) dominated moist forests of the northern Rocky Mountains. The fast-growing species, which can reach heights of 150 feet, was once an economic driver in the region. However, not much of the former forest remains. A combination of blister rust, beetles, and logging severely reduced the range of white pine during the 20th century.

Management Need: Managers have traditionally used large clearcuts followed by broadcast burning to grow western white pine and other early seral species. While this approach can be an effective and efficient way to get white pine on the landscape, clearcutting can come at the expense of other objectives, such as aesthetics, wildlife habitat, and water management.

Research purpose: Over a decade of research by Rocky Mountain Research Station scientists Terrie Jain and Russell Graham is now providing updated guidelines for regenerating and establishing white pine on the landscape by focusing on factors such as forest openings and visible sky.

Silvicultural Concepts:

- The response of white pine under different canopy openings varied depending on whether there was a local source of water. On large slopes with lots of streams dissecting it, white pine did better across the opening sizes versus slopes that were not dissected by streams and creeks.
- For western white pine, there is a lot of mortality in the first 6 years of establishment, but after 6 years the trees that are still there have a good chance of remaining. After 6 years, if western white pine is established, it "captures the site," outcompeting grand fir and hemlock to become the dominant canopy species.
- At 55 percent canopy opening, western white pine has competitive advantage, growing faster than western hemlock. At 92 percent opening, western white pine is free to grow, meaning it will likely become the dominant tree in the canopy (table 1).
- A sunfleck is a short period of direct sunlight. The number of sunflecks that affect a seedling has a negative relationship with growth. Jain and Graham found it is best to leave overstory trees in clumps rather than evenly spaced. This decreases the number of sunflecks and increases the period of direct sunlight reaching the established trees.

Management Applications:

- James Pass, Forest Silviculturist: "It is possible to leave 40 square feet of basal area in the overstory, and leave the trees as dispersed or aggregated." If you distribute the trees in a dispersed pattern where you have a tree every 40 feet, that's not a good light environment for western white pine or larch. What you want to do is create aggregations and some clumps so there are fewer sunflecks hitting the ground and lasting only for a short period. If you have a clumped-up, aggregated retention, then you'll have longer periods of sunlight hitting the seedling and it will grow better. The research helps people actually put themselves in place—as weird as it may seem— to think like a seedling and imagine the influence exerted on a seedling by its surroundings,"
- Jason Jermon, District Silviculturist: "The idea is to get enough light in the openings to get the seedlings established, then establish more seedlings in the second entry, but make sure the original seedlings achieve free-to-grow status. They can actually gain competitive advantage and free-to-grow status because we've expanded the opening and increased the amount of visible sky to the seedlings.

Table 1—Costs associated with stand improvement accomplishments in fiscal year 2020.

Figure 1—55 percent visible sky

Figure 2—92 percent visible sky

Table 1—For each opening threshold there are practical estimates of a range of basal areas, stand density indices, trees per acre, and opening sizes.

Threshold name	Threshold value (visible sky)	Basal area (ft^2/acre)	Stand density index	Trees/ acre	Opening size (acres)
55% regeneration establishment	25%	100 to 120	425	80 to 100	0.1
80% regeneration establishment	45%	80 to 100	350	60 to 80	0.25
Competitive advantage	55%	40 to 80	300	20 to 60	0.3
Free to grow	92%	≤ 40	≤ 120	≤ 20	1

References:

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It's all up from here: Forest openings and seedling growth in western white pine restoration. 2020. Fort Collins, CO: U.S. Department of Agriculture, Rocky Mountain Research Station, Science You Can Use Bulletin, July/August: 41: 11 p.