Effects of Logging-Debris Removal, Vegetation Control, and Site Quality on Stand Characteristics of Coast Douglas-Fir

Robert A. Slesak, Timothy B. Harrington

Overview:

- Pronounced positive effects of logging-debris retention and vegetation control influence 15-year survival and growth of Douglas-fir in western Pacific Northwest forests.
- Effects mediated by soil quality: logging-debris retention and vegetation control had greater efficacy at the site with low soil quality (low nutrient and water availability).
- Removal of logging debris facilitated establishment of invasive Scotch broom (*Cytisus scoparius*) on the site with low soil quality, which caused cascading negative effects on soils and native plant communities.
- Trees growing in proximity to mini logging-debris piles had greater survival and growth compared to those located away from piles.

Summary:

Silvicultural establishment practices can influence survival and growth of the succeeding stand, including effects on stand productivity and plant community composition. Vegetation control and logging-debris manipulation are two common practices that influence reforestation success, but their effectiveness is likely to vary with soil quality and its influence on plant resource supply. We established an experimental manipulation of logging debris (removed, retained, or piled) and vegetation control (initial site preparation or annual herbicide application for 5 years) at two sites that contrasted strongly in soil quality. Tree growth and survival, vegetation communities, and soil properties were monitored for 15 years to assess the effects of treatments. At both sites, annual vegetation control increased Douglas-fir volume, ranging from a 30% to 160% increase at the low-quality site depending on logging-debris treatment, and by 30% on average at the high-quality site. In general, effects of logging debris were more pronounced at the low-quality site. At that site, debris removal led to higher cover of the invasive Scotch broom (~55% greater than debris retained treatments) and concurrent increases in Douglas-fir mortality, and logging-debris retention favored establishment of native species cover and abundance (fig. 1). Trees growing in proximity to piled logging debris had greater survival (by 16%)

than those growing more distant, which was associated with increased amounts of available N and nutrients under the piles. Taken together, we conclude that cultural practices that influence competitor abundance and resource availability are critically important on low quality sites, but may not be necessary at high quality sites where resource availability is less constrained.

Silvicultural Concepts:

- Early growth of planted seedlings is constrained by the availability of nutrients and water, which is strongly controlled by soil properties and local climate.
- Cultural practices, such as logging-debris manipulation and vegetation control, can channel limited resources to planted seedlings, increasing their survival and growth (fig. 2).
- The efficacy of these practices is greatest at sites where resource availability is inherently constrained, including sites with soils that have low nutrient pools and available water.
- Retention of logging debris can benefit planted seedlings by modifying the growing environment of competing vegetation (inhibiting establishment of competitive grasses and Scotch broom and other nonnatives) and improving soil quality as organic matter is incorporated into the soil or provides a mulching effect to increase water availability.

Management Applications:

- Forest managers can utilize logging debris to increase reforestation success where retention does not conflict with other management objectives such as reducing short-term fire risk or keeping planting costs low.
- Logging debris may also inhibit establishment of nonnative plant species and provide other benefits such as reduced browsing.
- Higher costs of sustained vegetation control may not be warranted at higher quality sites since early benefits to growth appear to lessen with time as the stand develops.
- Findings are being operationally applied to increase survival of Douglas-fir and inhibit establishment of Scotch broom on droughty forest soils in western Washington.

Figure 1—Cover of Douglas-fir, the invasive Scotch broom, and native salal and blackberry by logging-debris treatment at the low-quality site.

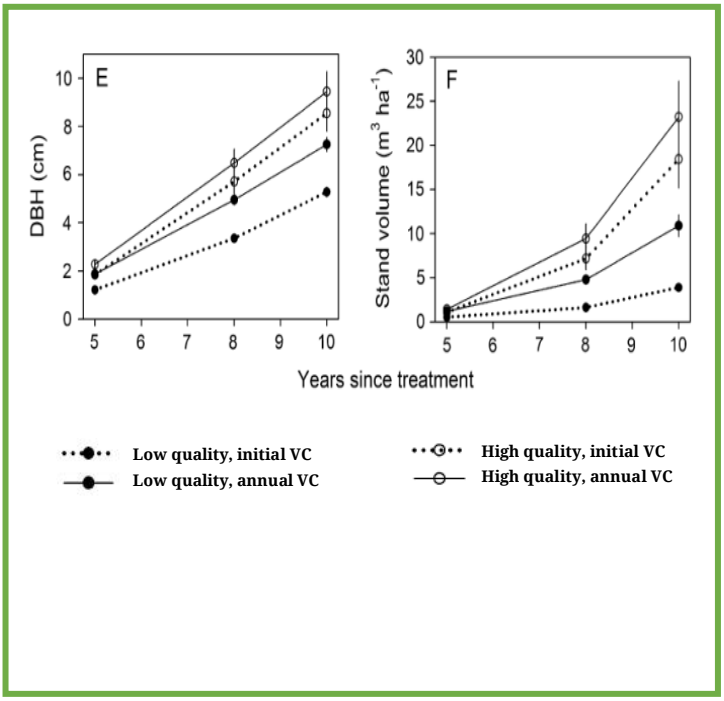

Figure 2—Douglas-fir survival (panel A), height (panel B), DBH (panel E), and stand volume (panel F) by vegetation control (VC) treatments (initial = site preparation; annual = sustained for 5 years) at high- and low-quality sites