

Effect of Pruning in Sitka Spruce-Western Hemlock Forests in the Pacific Temperate Rainforest

Kellen Nelson, Jeff Barnard, Preston Massingham,
Justin Crotteau

Overview:

Two experiments were designed to evaluate the effect of tree pruning on Sitka spruce tree characteristics and understory vegetation production.

Pruning lift height experiment:

- Experimental pruning treatments were applied to all trees within 0.2 hectare (0.5 acre) treatment plots at four sites on Prince of Wales Island, Alaska, USA. Pruning prescriptions included 2.4 m (8 ft), 3.6 m (12 ft), and 5.2 m (17 ft) lift heights and a no pruning control. Plots were thinned to 420 trees ha⁻¹ (170 trees acre⁻¹) immediately prior to pruning treatment. Plots were measured after establishment in 1991, 1992, and 1993, and remeasured in 1999, 2012, and 2021.
- The abundance of epicormic sprouts rose with pruning lift height in the first decade after treatment, but progressively diminished in all treatments after 20 and 30 years.
- Pruning lift height had no effect on understory biomass or deer forage when compared against the no pruning control treatment.
- Pruning reduced butt log taper.

Thinning and pruning experiment:

- Experimental thinning and pruning treatments were applied across 19 sites. Prescriptions included thinning but no pruning, thinning and pruning of 25% of trees, thinning and pruning of 50% of trees, and a no thinning/no pruning control. The thinning treatment was 420 trees ha⁻¹ (170 trees acre⁻¹) and pruning lift height was 2.4 m (8 ft). Plots were measured in 2008, 2013, and 2019.
- Thinning resulted in a significant increase in understory biomass and deer forage; however, supplemental pruning treatments did not increase understory vegetation production over thinning alone.



Summary:

Timber management in Sitka spruce / western hemlock temperate rainforests is increasingly focused on secondary even-aged stands that re-established after primary forest removal during the 20th century. After clear-cut harvest, abundant natural regeneration fosters rapid stand initiation forming dense, close canopy forests. Understory vegetation declines rapidly after canopy closure and is nearly absent during the prolonged stem exclusion phase of stand development. Productive understory vegetation is important for wildlife habitat and subsistence food resources across the ecoregion. Precommercial thinning is widely used to enhance crop tree growth and preserve or improve understory plant communities by reopening the canopy and increasing light transmission. Tree pruning can improve wood quality and may also enhance understory production through additional canopy light transmission. An improved understanding of the effects of silvicultural pruning is needed to guide management application of related prescriptions across Sitka spruce / western hemlock forests of North America. In this study, we utilize two long-term stand manipulation experiments on the Tongass National Forest, Alaska, USA to evaluate (1) how pruning lift height and (2) the proportion of trees pruned affects crop tree characteristics and understory plant communities.

Silvicultural Concepts:

- Pruning of Sitka spruce can improve live log characteristics by removing large branches that cause knots and reducing taper of the butt log. A more cylindrical tree bole is achieved because branch removal reduces growth on the lower stem but does not affect growth on the upper stem where branches remain.
- Epicormic branching exhibited a positive response to thinning and pruning in the first decade after treatment; however, epicormic branches declined after this initial flush (fig. 1). The abundance of large epicormic branches (i.e., > 3 mm diameter) was positively associated with pruning lift height during the first decade after treatment (not shown).
- Tree pruning at any intensity (i.e., 100%, 50%, or 25% of trees) does not appear to improve understory biomass or deer forage beyond the benefits of thinning treatment alone (fig. 2).
- A minor reduction in diameter growth increment was found in treated trees.

Management Applications:

- Tree pruning is an intensive silvicultural tending approach that can improve tree characteristics. In southeast Alaska, pruning treatments have been implemented with the intent of improving understory vegetation production for wildlife forage, but the efficacy of this application is understudied. Evidence from two long-term experiments



on the Tongass National Forest, Alaska, suggest that tree pruning provides little, if any, additional enhancement to understory vegetation beyond that of thinning alone. Pruning of Sitka spruce did improve tree characteristics through a reduction in butt log taper; however, Sitka spruce's tendency for epicormic branching may reduce benefits gained through pruning application. Ultimately, wood quality and grade need to be evaluated in a milling and sort yard study to fully understand the effects of pruning on clearwood development and knot reduction. Precommercial thinning and pruning are costly management strategies. Where management objectives aim to provide both merchantable timber and understory vegetation for wildlife habitat, managers should consider that thinning produces more observable benefits.



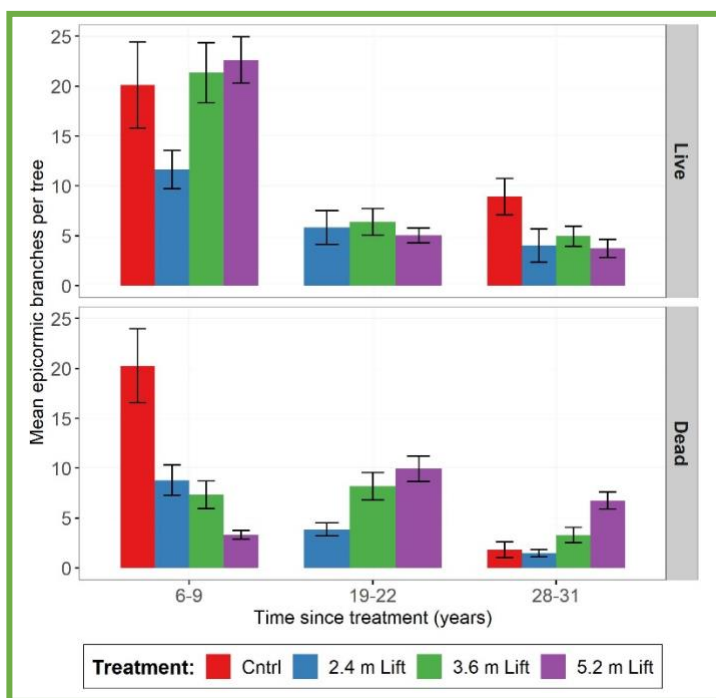


Figure 1—Epicormic branch formation on Sitka spruce was greatest in the first decade following experimental pruning lift treatments but steadily declined in the second and third decades after treatment on the Tongass National Forest, Alaska, USA.

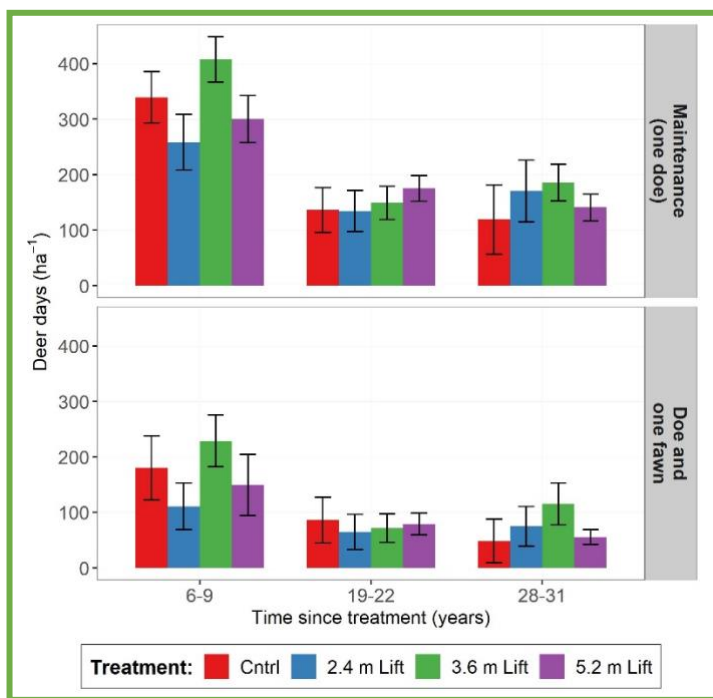


Figure 2—Pruning height does not affect deer forage. Deer days computed using understory biomass measured in experimental pruning lift treatments and the FRESHDeer model developed on the Tongass National Forest, Alaska, USA.