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Long-term response of planted conifers, natural regeneration, and vegetation to harvesting, scalping, and weeding on a boreal mixedwood site

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ABSTRACT

This study reports 14th-year response of a boreal mixedwood stand to different harvest intensities (uncut, 50% partial cut with and without removal of residuals after 3 years, and clearcut), spot site preparation treatments (none and scalped), and chemical weeding frequencies (none, single, and multiple) in northeastern Ontario. The response variables include the survival and growth of planted white spruce (*Picea glauca* [Moench] Voss) and jack pine (*Pinus banksiana* Lamb.), height and density of natural regeneration and shrubs, and cover of shrubs and non-woody vegetation. Harvesting and weeding generally improved survival and growth of planted trees, although white spruce survival did not significantly differ among the three weeding frequencies. Harvesting tended to increase heights of hardwood (mostly trembling aspen (*Populus tremuloides* Michx.)) and conifer (largely balsam fir (*Abies balsamea* (L.) Mill.).) natural regeneration, cover and density of shrubs, and cover of herbs, lichens, and ferns. Chemical weeding reduced height, density and cover of shrubs, height and density of hardwood regeneration, and fern cover, but increased moss and lichen cover. Spot scalping did not significantly affect planted seedling, natural regeneration, or the vegetation.

Maximum survival and growth of planted white spruce and jack pine were achieved using a combination of clearcutting and multiple weeding. However, partial cutting followed by a single weeding produced acceptable survival and reasonable growth of planted trees, particularly for white spruce. Partial canopy removal alone substantially reduced the amount of hardwood regeneration, relative to clearcutting, but did not adequately suppress understory shrubs. Significant improvement in seedling growth following multiple weedings was evident primarily in the complete canopy removal treatments: 50% partial cut with removal of residuals after 3 years and clearcut. While the effects of harvesting and weeding on planted crop trees found in the 5th-year assessments generally persisted at year 14, survival decreased, likely due to light competition from developing hardwood and shrubs.

1. Introduction

Partial harvesting is a silvicultural technique that has long been used in the boreal mixedwood forests to promote the natural regeneration of shade-tolerant conifers such as white spruce (*Picea glauca* [Moench] Voss) (Lees, 1963, 1964; Sutton, 1964; Waldron and Kolabinski, 1994; Ball and Walker, 1995; Prévost and Pothier, 2003), which can be difficult and costly to establish on clearcut sites due to rapid establishment of vegetative competition (Cater and Chapin, 2000; Lieffers et al., 1993) and extreme microclimate conditions (Grossnickle, 1988; Man and Lieffers, 1997, 1999a). Recent support for partial harvesting in boreal mixedwood stands is driven largely by interest in maintaining biodiversity and ecosystem processes at stand and landscape levels (Harvey et al., 2002; Thorpe and Thomas, 2007; Man et al., 2008). This includes patterning management after natural stand dynamics as would occur via succession (Harvey and Brais, 2007) and following non-stand replacing disturbances (Bergeron et al., 1999; Bergeron and Harvey, 1997) such as insect and disease outbreaks and wind (Chen and Popadiouk, 2002; Pham et al., 2004).

Regeneration of partially harvested stands, mainly conifers, can occur via advance regeneration that is well established prior to harvesting (Lieffers et al., 1996; Greene et al., 2002; MacDonald et al., 2004). The abundance of this advance regeneration is often sufficient for the next crop (Popadiouk et al., 2004) and protecting it during harvesting shortens rotation time and reduces cost associated with regeneration and stand tending (Lieffers et al., 1996; Greene et al., 2002; MacDonald et al., 2004).

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