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Managing impacts of *Kalmia* and salal on tree growth

by Robert Bradley

Highlights

- Harvesting systems, such as careful logging and variable canopy retention systems, often promote the invasion and growth of *Kalmia* and salal.
- Wildfire and prescribed burning result in *Kalmia* and salal reduction and improve growing early conditions for conifers at the same time.
- Scarification benefits conifer seedling growth and reduces ericaceous shrub competition.
- Fertilization reduces 'growth check' induced by *Kalmia* and salal on poor fertility sites.

In many disturbed boreal systems, regeneration of conifers is slowed by the invasion of some evergreen ericaceous shrubs, such as *Kalmia* and salal, both of which are extremely efficient at capturing nutrients. What does this mean in terms of the growth of the conifer seedlings? Invasion of ericaceous shrubs often leads to reduced growth and chlorosis of conifer seedlings. How do current silvicultural treatments, such as fertilization, scarification, burning, shelterwood harvesting and harvesting with minimum soil disturbance affect colonization of these shrubs? The mechanisms behind the slow conifer growth in some ericaceous systems are not clear and need to be understood in order to guide management practices that restore forest stands with desirable characteristics. This note provides an overview of the nature of ericaceous shrubs and their colonization patterns and discusses management practices that can alleviate growth problems due to ericaceous shrubs.

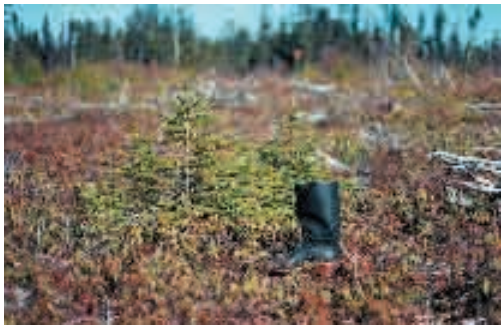
Ericaceous plants spread quickly

The Ericaceae or heath family occurs in a variety of environments and includes such common species as bilberries, huckleberries, blueberries, cranberries and rhododendra. Many ericaceous plants are valued for their fruits, which provide food for humans and wildlife, as well as for their ornamental appeal. Certain densely growing, ericaceous shrubs, however, such as *Kalmia* (*Kalmia angustifolia*) and salal (*Gaultheria shallon*), are considered weeds that may impose serious nutritional and growth limitations on conifer seedlings. *Kalmia* is found in eastern Canada, from Ontario to Newfoundland, whereas salal occurs mainly along the coast of British Columbia. Their main form of colonisation is through vegetative means. Both shrubs have very diversified root systems (surface and tap roots), which allow them to tap groundwater in times of drought. Their root systems are often so interwoven and dense that they are difficult to excavate on harvested and partially harvested sites. *Kalmia* and salal are also well adapted to withstand waterlogged conditions. Thus, it is possible to find *Kalmia* and salal occurring on a variety of soil types, from coarse textured mineral soils to organic matter rich boggy soils even though their preferred habitat consists of rotten logs and stumps.

Conifer seedling growth reduced

Coastal B.C. forests are often densely populated with an understory layer of salal, whereas black spruce forests in eastern Canada are often associated with an understory layer of *Kalmia*. Both shrubs can cause a phenomenon known as growth check: a reduction in conifer seedling growth and nutrient deficiencies. In Newfoundland, for

example, stem height and basal diameter of 15-year black spruce was reduced by 65 and 51%, respectively on sites with 36% *Kalmia* coverage compared to sites with <1%.[5] However, exactly how the shrubs cause growth check remains unanswered. Some research suggests that the invasion of ericaceous shrubs is linked to a decrease in soil nutritional quality, particularly a decline in soil nitrogen.[2] Other studies have pointed to the production of phytotoxic chemicals, which directly inhibit conifer seedling growth.[4] Another mechanism could relate to the expansive root system of *Kalmia* and salal and their ability to outcompete conifers by better exploiting the soil.[3] Whatever the mechanism, it is clear that growth check does not appear to persist after canopy closure.



Sixteen year-old, chlorotic black spruce seedlings exhibit growth check in a sea of *Kalmia*.

Silvicultural practices affect the growth of *Kalmia* and salal

Since both *Kalmia* and salal are opportunistic species that take advantage of a wide range of growing conditions, it follows that both species grow well following disturbance. Which harvesting and stand management conditions are favourable for *Kalmia* and salal establishment?

Fertilization may prevent invasion on poor sites

Nutrient rich sites seem to be less vulnerable to conifer seedling growth check than nutrient poor sites and studies have shown that fertilization with nitrogen improves conifer growth.[6] Preliminary results show positive growth responses to slow release fertilizers and nutrient loaded seedlings on poor sites with the greatest response resulting from the slow-release fertilizers.[1] Since growth check depends on the speed at which canopy closure occurs, fertilization could provide a temporary soil fertility solution and may therefore, be a viable silvicultural practice.

Careful logging can promote conditions for invasion

Harvesting systems that protect pre-established tree regeneration and minimize soil disturbance, such as Quebec's CPRS (cutting with protection of regeneration and soils) or "careful logging" maintain some low canopy vegetation and leave organic surface horizons relatively intact. They also create conditions favourable to a rapid spread of ericaceous shrubs with deep forest floors that remain cool in the spring and offer a home for the invasive root system of *Kalmia*. A recent study found that 93% of the fine roots in the surface organic horizon on sites recently harvested with CPRS were associated with ericaceous shrubs (mainly *Kalmia* and Ledum) while only 7% were associated with conifers (mainly black spruce).[8] This suggests that while ericaceous shrubs may constitute an important component of soil nutrient dynamics on these sites, they also limit conifer seedling growth.

Scarification increases seedling growth

Recent studies in the Abitibi and North Shore regions of Québec are showing unequivocal evidence that scarification in *Kalmia* dominated cut blocks significantly reduces growth check of both slow (black spruce) and fast growing (jack pine) conifer seedlings.[9] Ten to 15% less *Kalmia* coverage has been observed with scarification (compared to 35% *Kalmia* cover in control treatments) as well as an increase in black spruce height growth (10 cm/year) in the first 6 years after scarification. Scarification increases the distance between each planted seedling and the nearest *Kalmia* plant as well as fragments of the rhizomatous root network thus reducing the dominance of *Kalmia*. Other beneficial effects of scarification on conifer growth may be an improvement in drainage on wet sites, an increase in soil temperature, and higher nutrient mineralization rates.

Burning reduces salal and Kalmia *invasion*

In coastal B.C. where surface humus soil is very deep, broadcast burning has been prescribed to favour the establishment of conifer seedlings. Immediately following a burn, planted seedlings generally grow well until, on some sites, salal re-invades and dominates, usually 5–8 years later.[10] It is not known, however, if salal induced growth check is more severe if sites are not burned. In eastern Canada, prescribed burns are less frequent. One experiment conducted in Newfoundland showed a reduction in the number of *Kalmia* stems and percent cover following a burn.[7] Recent work in Québec has shown that 50-70 years after disturbance, significantly more ericaceous shrubs are present on harvested sites compared to sites that regenerated naturally after fire.[11] It is unclear, however, if prescribed burns have a lasting effect on *Kalmia* that translate into significantly higher yields of black spruce.

Post-fire, this once forested site in Newfoundland reverted into a Kalmia dominated heath.

Burning does not automatically curb the invasion of salal.

Harvesting affects growth of Kalmia and salal

Closed canopy conifer stands are often overstocked, resulting in thin stems and stagnating growth. In order to increase the value of these stands, extensive management practices such as pre-commercial and commercial thinning have been used to reduce stand density and increase the diameter growth of remaining stems. More recently, shelterwood harvesting/strip-cutting have also been employed. Such partial harvesting and the widely applied CPRS harvesting system in Quebec result in greater light availability to understory plants, which, consequently, may provide optimum light conditions for rapid rhizomatous growth and spread of *Kalmia* or salal. Since the rapid dominance of a site after disturbance is accomplished by re-sprouting from rhizomes, it is highly likely that the ericaceous bud-bank will increase significantly following variable canopy retention practices.

Summary

Kalmia and salal spread quickly with their vegetative growth patterns and can cause a reduction in early conifer growth. Some forest management practices can create conditions favourable for the establishment of these shrubs, while other practices discourage it. Careful logging and variable canopy retention practices often result in increases in ericaceous shrubs while fertilization, scarification and fire (prescribed and wild) improve early conifer growth and reduce competition with Kalmia and salal.

Implementation

- **Where Kalmia and salal cause conifer growth reduction, thinning and partial harvesting practices can exacerbate the problem; where there is no feasible alternative to these practices, fertilization and scarification could reduce the impact of these weeds on conifer growth.**
- **If practical, fertilization can be used on poor fertility sites to mitigate conifer growth check induced by ericaceous shrubs.**
- **Wildfire and prescribed burning often result in improved conifer growth through improved nutrition and reduced competition from Kalmia and salal.**
- **Scarification is recommended where growth check is a problem since it reduces competition between conifer seedlings and ericaceous shrubs; and enhances nutrition, at least in the short term.**

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