The Role of Microtopographic Variation in Forest Reclamation

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Abstract

Surface mining is an anthropogenic disturbance which significantly alters natural ecosystems, involving the removal of vegetation, top and subsoils, and several metres of overburden material before accessing valuable resources. Forest reclamation efforts following surface mining face several challenges due to the severity of disturbances following resource extraction. This process begins with reforming landscape features using overburden materials which struggle to support the growth of forest vegetation. Salvaged soils are a suitable growth medium for planted tree seedlings and colonizing vegetation, however, current coversoil application practices fail to capture surface level spatial heterogeneity characteristic for natural forests. This variability contributes to altered soil edaphic conditions, providing a range of microsites suitable for the growth and establishment of trees and vegetation.

This study assessed how the creation of spatial heterogeneity on reclamation sites by mechanically manipulating coversoil types and microtopography (0 – 1 m scale) impacts the growth and establishment of planted *Populus tremuloides* (trembling aspen), *Pinus banksiana* (Jack pine) and *Picea glauca* (white spruce) seedlings and the natural colonization of woody species. At a finer scale, the growth responses of planted seedlings to specific microsite positions were also investigated. At an operational scale, two constructed microtopographical treatments (ridged and hilled) were compared to a levelled treatment which represents widespread operational practices. Two different coversoil materials (salvaged upland forest floor material (FFM) and lowland peat mineral mix (PMM)) were used.

The results from this study indicate that planted seedlings grew larger in height and root collar diameter in the treatment with the greatest microtopographic variation (hilled), particularly when applied on a south-facing site with greater exposure; however, the magnitude of the response differed among planted species. The natural colonization of woody species also increased with microtopographic variation, where the sheltered toe position in the hilled treatment and the PMM material type were preferred establishment sites. At the microsite scale, planted seedling growth differed more among planting positions on FFM (coarser) hills, while differences were small among microsites on hills made of PMM coversoil. Most of the observed responses appear to be driven by the availability of water rather than variations in temperature and nutrient conditions. As a result, the use of increased surface soil variation (via different coversoil materials and microtopography) will likely be more effective on reclamation sites with greater exposure to conditions such as drought and can significantly benefit forest restoration efforts on these exposed sites.