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Natural revegetation on forest topsoil and subsoil along roadsides in boreal forest

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Abstract

Questions: Does natural revegetation from indigenous soil improve the restoration success of roadside areas? What are the effects of topsoil, subsoil and fertilization on natural revegetation?

Location: Akershus county, SE Norway (10°25' E, 59° 44' N).

Methods: We used a recently constructed road through a boreal coniferous forest for a three year (2000–2002), fully replicated revegetation experiment (six replications). Treatments were soil type (two levels; one topsoil and one subsoil type) and fertilization (two levels; NPK and unfertilized control). Ordination methods, constrained ordination methods as well as univariate statistical methods, such as Wilcoxon's signed-rank test and correlation analysis, were used to assess the relative importance and significance of treatments on the plant species composition.

Results: There was no fertilization effect on species composition. The species composition on both soil types was stabilised by the second year. The species dominating the topsoil were more in accordance with the indigenous vegetation than was the case on the subsoil. The significant difference in species composition among blocks, persisting for the entire study period, indicated that local factors are important determinants of the outcome of revegetation.

Conclusion: Unfertilized topsoil provides a revegetation result in better accordance with the indigenous vegetation than does subsoil.

Keywords: Fertilization; Norway; Ordination; Restoration; Vascular plant; Vegetation dynamics.

Nomenclature: Lid & Lid (1994).

Abbreviations: HC = Half change; ICP = Inductively coupled spectroscopy; GNMDS = Global Non-metric Multidimensional Scaling.

Introduction

For decades, roadsides have been planted and seeded to control soil erosion and for aesthetic reasons (Laukli et al. 1999). Scientific and practical studies have been carried out to find the optimal plant species and planting techniques. Nevertheless, the planted and seeded vegetation alongside many roads fails to establish successfully, and the goal "to restore degraded areas and to improve road aesthetics within the natural landscape" (Anon. 1992) is often not achieved (Laukli et al. 1999). In contrast, old roadsides in rural areas that were never planted or seeded often revegetated naturally (Laukli et al. 1999). The natural revegetation process, defined as the revegetation process where no seeds or spores of vegetative parts (propagules) are added to the soil, is common in many ecosystems and occurs on a variety of scales, ranging from small forest floor gaps (Jonsson & Esseen 1998; Rydgren et al. 2004) to revegetation after continent scale glaciations (Blytt 1876; Matthews 1992).

Soil in boreal forests, and elsewhere, is often multilayered. In most road construction, the soil is regarded as one layer, but in this study we divide the soil into topsoil and subsoil. Topsoil is a broad term always including the upper part of the soil horizon with the organic layer and the larger part of the propagule bank (Munshower 1994). In the present study, the topsoil is defined as the upper 30 cm of the soil. The subsoil is defined as all soil layers not included in the topsoil. Most road constructions result in road verges dominated by exposed subsoil, simply because subsoil occurs in larger quantities than topsoil. Revegetation from subsoil often requires amendments such as fertilization, and natural revegetation on subsoil will often take time since there is no propagule bank and the propagules need to disperse from the surrounding area. Natural revegetation by the removal, storage and redistribution of topsoil provides a simple, alternative method to seeding and planting on subsoil. Natural revegetation from topsoil has been used as a method for restoring degraded land throughout the world for several decades, although this method has been underrepresented in revegetation studies (e.g. Bell et al. 1990, seeding; Wali 1999, seeding; Petersen et al.