



### Technical Note

# Site Disturbance: Effect on Vegetation Establishment and Succession

## Introduction

This Technical Note provides basic background information on the impact of industrial disturbance on native plant communities and discusses issues of natural regeneration. When planning or conducting forest reclamation, the ultimate goal is to produce a self-sustaining plant community that resembles, as closely as is practical, either the immediately adjacent or surrounding forest community.

The scale of small industrial disturbances, and the nature of their impacts on the soil, makes fire an unsuitable natural analog. Better choices for a natural disturbance analog for reclamation purposes are soil slumps or soil mass wasting disturbances. These disturbances are on the correct scale for small industrial disturbances, and result in more similar site conditions with mixing and exposing of mineral soil. Though the return of topsoil to disturbed areas may restore some of the biological legacy to a site (i.e., organic matter and nutrients), conditions will favour species with broad tolerance to site conditions, good colonizing ability and fast growth.

When considering plant and plant community interactions it is necessary to include both establishment phase and longer term interactions. Long term interactions of plant species must include anticipated competitiveness shifts along the expected succession pathway (e.g., changing light, moisture and nutrient conditions over time). The *Field Guide to Ecosites of Northern Alberta* (Beckingham and Archibold 1996) is the suggested resource tool for use in long term planning. The ecosite guide describes only the mature community condition (> 40 years) and was compiled from homogeneous stands.

## Establishment phase

The literature often describes a distinct phase of plant community development called establishment. The establishment phase includes the first few growing seasons where young or juvenile plants face a set of challenges that may be very different from those experienced at maturity. The presence of competing vegetation, especially agronomic ruderals common on disturbed soil, can extend the establishment phase, particularly for some woody plants with slow growth rates. A common problem with sites reclaimed under past guidelines (i.e., prior to 2010 forest criteria) is the abundance of grasses that effectively capture the site and limit or prevent the establishment of other plants. Many native boreal forest species are not well adapted to compete with dense herbaceous vegetation, and extended periods with little or no natural ingress from surrounding native plant communities, combined with high mortality of woody species, is common. Establishment of woody plants is a core reclamation criterion under the forest 2010 reclamation guidelines in Alberta. For this reason, plans must consider both the requirements for establishment of the desired woody plant species, and the potential interactions with other species. For example, following natural disturbance, aspen, poplar, birch, and alder are able to establish quickly and successfully from dormant buds even in the presence of aggressive competition that would prevent establishment from seed. To successfully establish from seed these same species require relatively low levels of competition, suitable seedbed microsite and stable moisture, conditions frequently lacking on industrial disturbance sites.

Considerations for the establishment phase include:

- **Space.** Suitable substrate and microsites are required.
- **Light.** Excessive light, or insufficient light for photosynthesis, must both be considered.
- **Temperature.** Small forest openings can suffer from increases in seasonal or night time frosts, and elevated daytime surface temperatures.
- **Moisture.** Sufficient moisture near the soil surface is required for plants during establishment. Surface moisture conditions may be limiting even when moisture conditions deeper in the soil profile are adequate.
- **Propagule bank.** The presence of ruderal species that may compete with desired plant species. Many agronomic ruderals establish on industrial sites during the site active phase as agronomic grass and legume species are used to stabilize ditches and road cuts. These species as well as weed species that travel in either with seeds or on construction or mowing equipment are quick to capitalize on the growing space offered by disturbed soil.

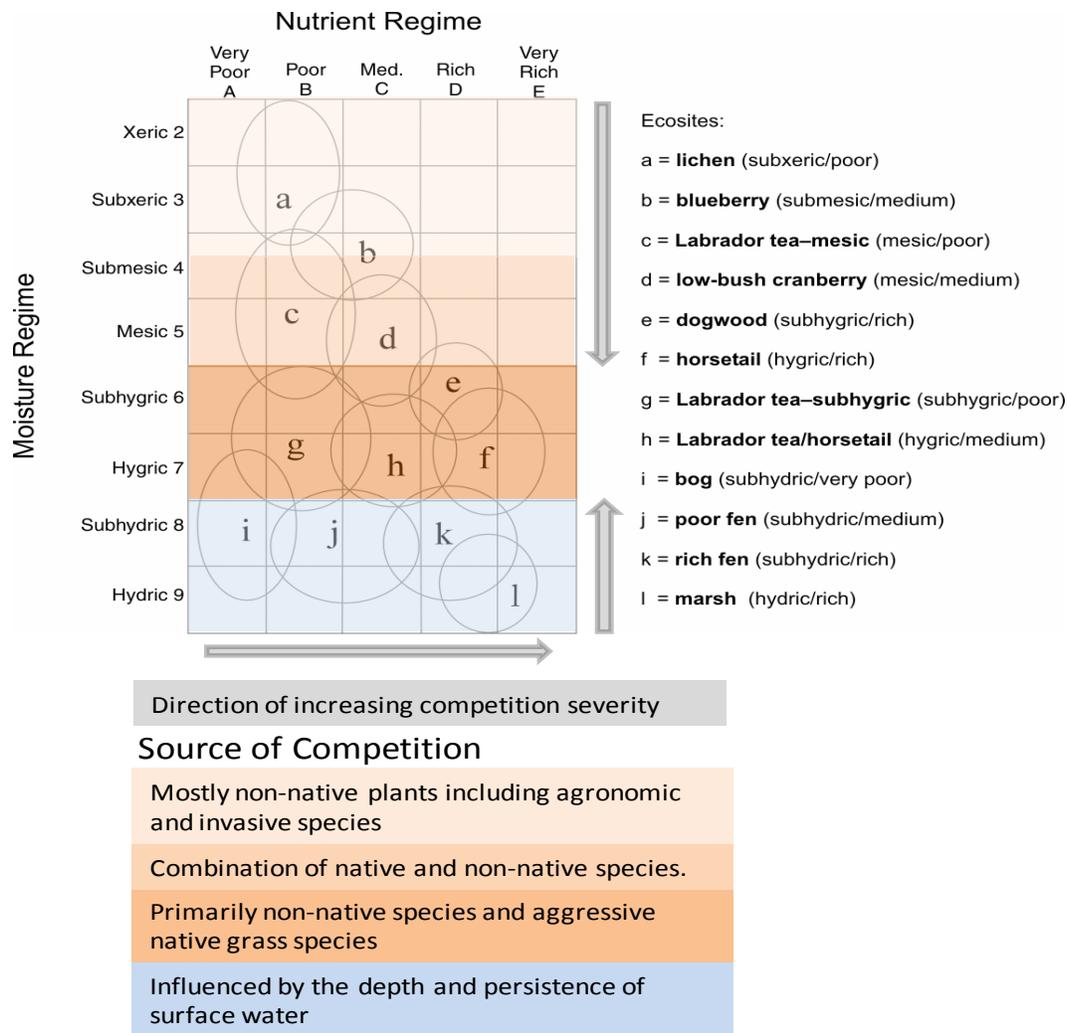
## Competition

Many factors can influence competition. Physical factors, environmental stress, predation, and recruitment combined have been used to predict the expected level of plant competition (Menge and Sutherland 1987).

The expected severity of competition will change depending on the species present on the site. When present, ruderal plants (plants that establish and grow well on disturbed ground) will dominate recently abandoned industrial disturbances. Most agronomic and other non-native weeds are considered ruderal species and are aggressive persistent competitors of trees and other woody plants. Some native ruderal species, including fireweed (*Epilobium angustifolium*), bedstraw (*Galium spp.*), vetch (*Lathyrus ochroleucus*) and several native grasses (e.g., *Calamagrostis canadensis*) are also prolific colonizers of disturbed ground and may compete aggressively, particularly with slow growing trees.

For management purposes, competition is best broken down by type or source of competition and the anticipated severity of competition (Figure 1):

- On dry recently abandoned sites competition will mostly be from non-native plants including agronomic and invasive species, and overall competition will be less severe than on moister or richer sites.
- On medium sites competition will be from a combination of native and non-native species, with the severity of competition increasing with soil nutrient status.
- On wetter sites competition will primarily be from non-native species and aggressive native grass species.
- Competition on wet sites is greatly influenced by the depth and persistence of surface water that acts to limit the species pool able to establish and grow.



**Figure 1.** Edatope for boreal mixedwood ecological area of Alberta (Beckingham and Archibold 1996) indicating the most likely source of competition and direction of increasing competition.

## Plant communities and succession

The boreal forest is characterized by periodic natural disturbance, and seed is not the primary method of establishment for many species. Most plants in the boreal forest have some adaptation or combination of adaptations to either avoid removal and/or re-colonize after disturbance. Avoidance strategies include seed banking, serotinous cones, and regeneration from roots or dormant buds. After disturbance, plant species that use an avoidance strategy typically have a narrow window for establishment (one or two growing seasons) that closes quickly once other plants establish and competition begins.

Re-colonizing strategies typically include the ability to produce abundant and widely dispersed seed. Often species that are good re-colonizers are also capable of rapid vegetative reproduction (often from roots or rhizomes) once re-established from seed.

Though often considered re-colonizers, white spruce and fir establish best on mineral soil microsites exposed by disturbance. Establishment of white spruce and fir is limited primarily by seed availability (including short seed dispersal distance and seed abundance) and suitable microsites for establishment.

Natural plant community succession in the boreal forest does not involve a complete turnover of species, but rather appears as a change in relative species abundance. Though some species are only abundant immediately following disturbance, most of these remain as minor components of older forests. Early post disturbance plant communities are a combination of species that have successfully employed an avoidance strategy, have re-colonized from undisturbed forest, or both. With the possible post-fire exceptions of aspen that can regenerate in great abundance from root suckering, and pine that can recruit abundantly from seeds dispersed from serotinous cones, the early plant community is dominated by re-colonizers. Depending on the nature of the disturbance and its effect on the forest floor, the domination by re-colonizers may last as little as one season or persist for several years. With time, the space for continued ingress from seed becomes less, and light, temperature, and moisture conditions change and/or become more moderate. These changes over time result in a shift in species abundance toward the mature forest community condition.

Unlike natural disturbances (e.g., fire, insect outbreaks, and wind) that leave most soil in place, industrial disturbances will disadvantage those species using avoidance strategies and favour ruderal species. Proper topsoil salvage and timely replacement is the only ameliorating action possible for most avoidance strategy species. Because they often have difficulty establishing from seed, after topsoil placement effective vegetation management is the only option for extending the window for ingress and establishment of native species that typically employ an avoidance strategy.