Microtopographic patterns in treated & untreated seismic lines & its implications for tree re-establishment

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Introduction

Boreal forests in northeastern Alberta are continually fragmented by and gas exploration with the most common disturbance being seismic lines[1-2]. Forest regeneration and recovery rates in these areas are often less than adequate with only 8.2% of seismic lines across forest types having recovered to woody vegetation with > 60% of seismic lines persisting as open after 35 years[2]. It has been suggested that simplification of microtopography on seismic lines substantially reduces tree regeneration by removing microsites for tree recruitment, especially in peatlands where lines are prone to flooding[1,3,4]. The lack of microtopographic variation is likely associated with a reduction in the ability of *Sphagnum* moss to establish due to the effects of flooding[3]. Mounding treatments should therefore benefit natural regeneration and survival of planted trees, especially in treed fens due to the need to mitigate flooding but more needs to be done to assess its effectiveness.

Figure 1. A mounded and planted seismic line in a bog in the Kirby site area

The objectives of this study were to: (1) compare microtopography between seismic lines (treated and untreated) and adjacent forests; and (2) assess relationships in microtopography on seismic lines with patterns in forest regeneration.

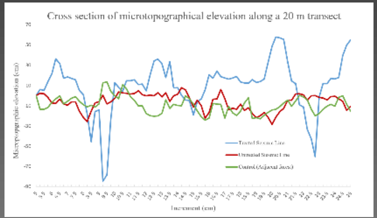

Figure 2. Cross section of microtopographic elevation (cm) along an example 20-m transect (increments of 25 cm) of treated, untreated seismic lines, and control sites.

Study Area

The study area lies between Cold Lake and Fort McKay in northeast Alberta with the Kirby site treatments south of Conklin the focus of this report Figure 4). The area is dominated by treed peatlands of bog, poor fen, rich fen and poor mesic ecosite type. A total of 22 paired plots (seismic + forest) were completed here in the summer of 2017 (Figure 4).

Figure 3. Seismic line treated with mounding and planting treatment(left) and seismic line untreated (right).

Methods

1. A high precision hydrostatic altimeter (ZIPLEVEL PRO-2000 with 0.0127 cm accuracy) was used to measure the elevation profile along the main seismic axis (25 cm spacing between 5 and 25 m of the 30 m transect) and along its perpendicular profile (25 cm spacing across the full linewidth at 3 locations). Measurements were then converted to values of average absolute deviation for each transect to quantify variation in topography;
2. Controls were measured 25 m from the seismic line in the adjacent stand with a paired 30 m transect; and
3. Vegetation regeneration on seismic lines were assessed along 30 m transects with belt quadrats (1x30 m) used to measure shrub/tree density

Figure 4. Locations of 22 paired study plots of either untreated or treated seismic lines as measured in the summer of 2017.

Results

Overall, we found no change in topographic variation on untreated seismic lines compared to adjacent forests and more than a 3-fold increase on seismic lines that were mounded compared to untreated seismic lines. Regeneration was not related to topographic variation in control forests, while black spruce regeneration was related to topography in untreated seismic lines, but not other species. And finally, tree regeneration in treated seismic lines (mounded and planted) was positively related to topography in larch and aspen, but not black spruce.

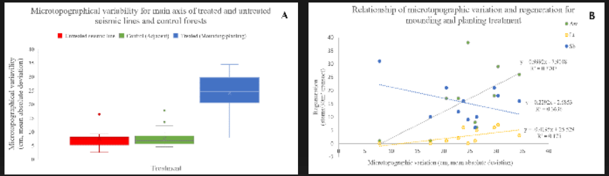

Figure 5(A) Microtopographic variability (cm, mean absolute deviation) for main transect of treated and untreated seismic lines as well as controls. Untreated seismic lines were not significantly different from adjacent control forests. Treated seismic lines had significantly higher microtopographic variation compared to both untreated and controls sites **(B)** Tree regeneration as a function of microtopographic variation (cm, mean absolute deviation) for aspen and larch.

Discussion

Contrary to our expectation, our preliminary results do not indicate that seismic lines differ in microtopography from adjacent control forest, but were depressed overall in cross-section (not shown). Interestingly, microtopography was not correlated with increased regeneration for black spruce in mounding treatments, but was for aspen & larch. This helps guide management regarding the success of mounding and planting treatments. This study also provides insight into the use of a novel tool for measuring microtopography. This study could be continued to assess the longevity of mounding treatments over time and further assess the effects of microtopography at broader scales or across ecosite types. Results are likely to be site specific. Caution should be given to extrapolating these results elsewhere.

Acknowledgements

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