Seismic Line Impacts on Proximal Boreal Forest and Wetland Environments

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ABSTRACT

Seismic lines, corridors cut through the forest and used for geophysical exploration of oil and gas deposits, are constant linear disturbances found in Western Canada’s Boreal Forest. The linear extent of seismic lines in Alberta exceeds 1.5 million km, and are often found at densities greater than 10km per km2. These features cause reduction of habitat area and increased fragmentation, thus increasing the ratio of edge to interior habitats. In addition, seismic lines can disrupt energy and water fluxes within the broader local environment and may influence the productivity of vegetation species. Due to their ecologic disruption, there is need for government and industry to reclaim these features and monitor ecosystem change over time. Our study utilized a state-of-the-art airborne multi-spectral lidar dataset obtained across a boreal upland-wetland environment in central Alberta. The objectives of this study are to: a) quantify the effects of seismic line attributes (width, cardinal orientation and age) and distance from seismic lines on proximal vegetation height and fractional cover in forest and wetland environments; b) assess interactions between vegetation structure and primary drivers of growth, including topographic position (an indicator of soil moisture), radiation, surface geology; and c) train a Random Forest (RF) model to determine how each of these interact and what the dominant drivers of spatial varia
tions in forest/wetland structures are adjacent to seismic lines.

We observed that seismic lines change the adjacent forested edge vegetation structure based on reductions in height and fractional cover. However, the extension of these effects was shown to vary depending on the width of the seismic line. The wider the seismic line, the greater the magnitude of the effect and the distance over which edge effects were observed. Wide seismic lines influenced height within 5m (p<0.0001) and extended into the natural forest by 60m (p = 0.6874) on east-facing sides, ranging from -3.82 meters to 0.74 meters. The influence on fractional cover began at 5m of the seismic line (p<0.0001) and extended until 55m (p = 0.7355), ranging from -0.18 to 0.03. Based on the RF analysis, distance from seismic line, incident radiation and water availability (via topographic position) were the most important variables for predicting changes in vegetation condition (indexed by height and fractional cover attributes) within 100 m of seismic lines.