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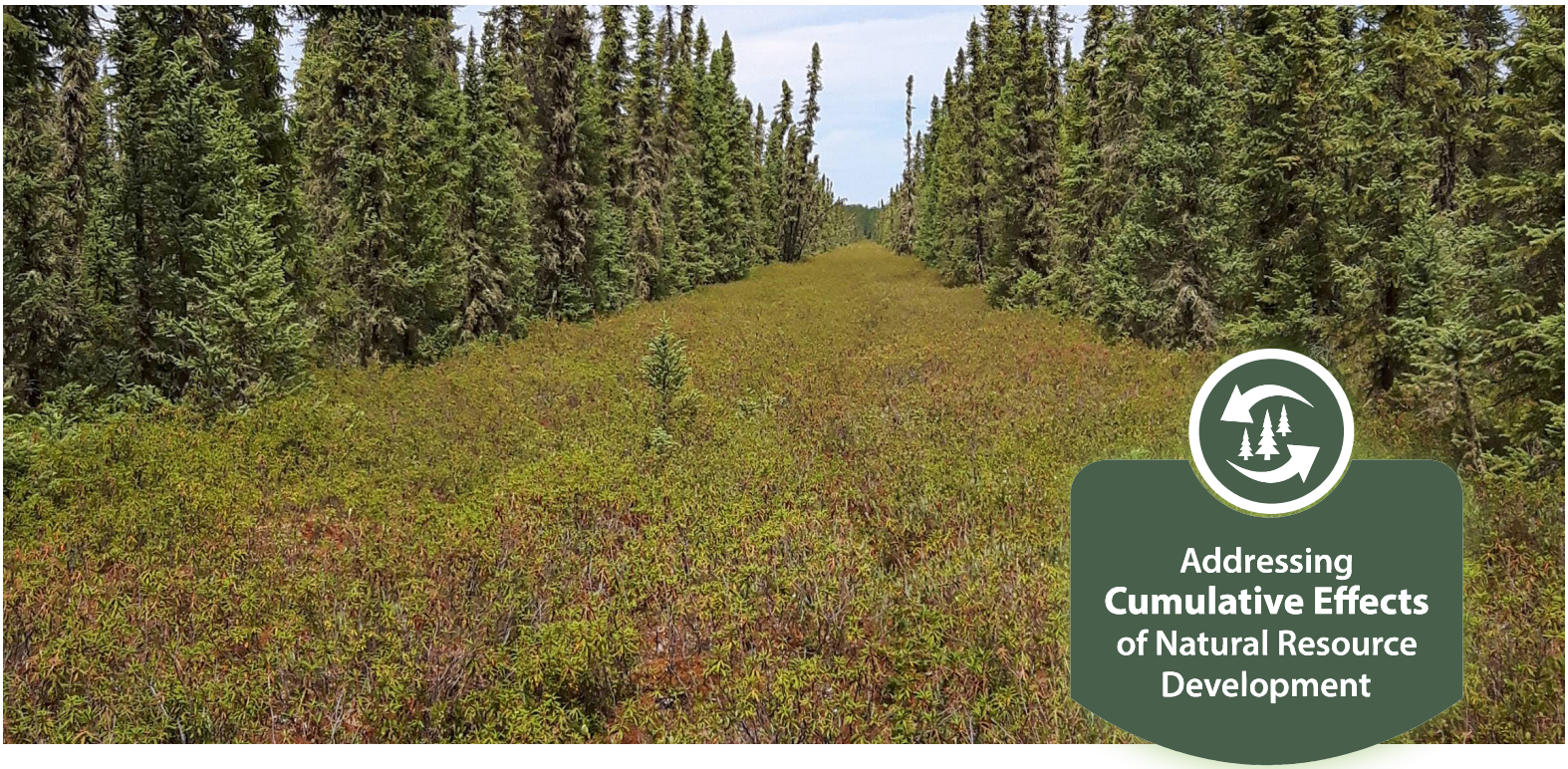
Research Connections: Cumulative Effects

Assessment and monitoring over time of edge influence and plant functional traits on seismic lines in northern Alberta: implications for successional trajectories and restoration practices

Note 4

Lead Researcher: Anna Dabros (NoFC) **Project Type:** Caribou and Cumulative Effects **Project Status:** Active (2021–2022)



Need/Drivers

A key factor in managing the impacts of the oil and gas (O&G) industry includes restoration of the ecological footprint left behind from O&G exploration. Exploratory seismic lines are narrow corridors constructed to transport and deploy geophysical survey equipment needed to determine the presence and depth of underground O&G reserves. The construction of exploratory seismic lines results in forest landscapes becoming fragmented. Both upland boreal forests and boreal peatlands constitute a primary habitat for caribou, so fragmentation of these ecosystems by seismic lines causes a direct disturbance to their habitat. Effects extending from the seismic line edge into the adjacent ecosystem may further magnify the ecological footprint of the lines, and potentially reduce the capacity for these linear features to regenerate naturally. There is evidence that edge effects can diminish with time as the disturbed areas regenerate. However, there is also evidence that edge effects can increase over time. This conflicting evidence calls for a closer look into the matter of edge effects of seismic lines, especially because there are still significant knowledge gaps regarding their impact on biodiversity and ecosystem functioning.

Ensuring that restoration priorities are properly allocated to achieve maximum environmental benefit at the lowest possible cost requires a better understanding of seismic line edge effects. This includes the impact that different restoration techniques may have on edge influence, and how this effect changes over time. This research will contribute key knowledge that will aid in decision-making about ecosystem restoration and land management, and will contribute to recovery efforts of endangered woodland caribou populations.

Approach

The research will be conducted at different types of seismic lines: conventional seismic lines and low impact seismic lines. It will also be performed in boreal upland and peatland forests. The objectives of this research can be explained in three phases. The goal of phase 1 is to measure the extent (i.e., distance of influence from the edge of disturbances) and patterns of edge effects in the boreal ecosystems adjacent to seismic lines. This will be accomplished by assessing the changes in native assemblages of living organisms (biotic factors: plants, lichens, arthropods) and their environmental conditions (abiotic factors: soil moisture, soil temperature, light, relative elevation). Line attributes (width, orientation, density, age and level of regeneration) will be used as co-variates. In phase 2, the objective is to assess how edge effects are changing over time. This phase will build on the research developed in phase 1, and will be accomplished by re-sampling the sites selected and sampled in phase 1 every five-seven years. In phase 3, the goal is to assess whether restoration treatment measures mitigate edge effects in adjacent boreal ecosystems, and assess the interaction of time and treatment on edge effects. This phase will build on the knowledge gathered in the previous two phases. In a separate project, we plan to test the application of remote sensing as a cost-saving tool to optimize restoration practices of seismic lines. We also plan to use remote sensing to help understand the ecological functions and processes that inhibit or promote succession on seismic lines in boreal ecosystems. A certain suite of characteristic conditions detected through remote sensing methods (structural, spectral, thermal) can then be used as indication of which plant functional traits are likely present on the seismic lines and in the adjacent forest. Knowing the dominant functional traits can be helpful in understanding the ecosystem properties and functioning at a smaller scale (i.e., the processes occurring on the lines and in the adjacent forest). This information can be used to determine if the lines are on the trajectory to recovery, or not, and why. This project will be conducted at multiple scales: at a small scale with data collection at the plot/site level, and at a larger scale using drone imagery. This will better allow for the development of integrated land management.

Anticipated Impacts

This research can help facilitate the stabilization of caribou populations by improving strategies to restore their habitat. The preliminary results of this work indicate that the negative effects of fragmented habitats can potentially be alleviated by considering orientation and other attributes of seismic line features. Knowing the attributes with the most negative impacts, and knowing how these impacts differ between upland forests and peatlands, will help mitigate these impacts in the future construction of seismic lines. In the long-run, this will reduce the need and cost of seismic line restoration. This project uses a novel approach aimed at the improvement of ecosystem-based strategies and tools to restore the ecological integrity of boreal ecosystems, which provide a prime habitat for caribou. Application of remote sensing to better understand the ecological functions and processes that inhibit succession may be a cost-saving tool in optimizing restoration practices in boreal ecosystems. Ultimately, the government can apply the scientific results of this research in decision-making and policy formation regarding the restoration of fragmented caribou habitat.

Project Location

Swan Hills, Peace River, Kirby Lake and sites in northern Alberta

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Publications

Dabros, A., Higgins, K.L., and Pinzon J. 2021. Seismic line edge effects on plants, lichens and their environmental conditions in boreal peatlands of northwest Alberta (Canada). Restoration Ecology.

Dabros, A., Hammond H.E.J., Pinzon J., Pinno B., and Langor D. 2017. Edge influence of low-impact seismic lines for oil exploration on upland forest vegetation in northern Alberta (Canada). Forest Ecology and Management. 400: 278–288.

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