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Forest Succession on Seismic Lines, Wellsites, and Roads

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Oil and gas exploration and development creates linear disturbances that affect boreal forest ecosystems by splitting up, or fragmenting, boreal forests. Over time, through the natural process of forest succession, natural plant communities regenerate.

Environmental assessments (EA) predict the effects of a proposed activity by comparing the planned disturbance footprint of a project to the existing disturbance. In a traditional EA approach, disturbances are assumed to remain on the landscape regardless of when they were constructed. This traditional representation of baseline – the condition that exists at the time a project application is submitted – does not take into account forest succession.

In reality, the disturbances created by oil and gas exploration and development do not remain on the landscape indefinitely, but regenerate through a process termed “forest succession.” Given that forest succession does occur on the landscape, representations of baseline in EA may overstate the amount of existing disturbance on the landscape.

Forest fragmentation has several effects on boreal forest ecology and on biodiversity in general. The clearance of lines in the boreal forest increases the accessibility by predators such as wolves (*Canus lupus*) and humans that use the linear disturbances as movement corridors (Dyer 1999, Dyer et al. 2001). Similarly, the movement of invasive plant species such as Kentucky bluegrass (*Poa pratensis*) and timothy (*Phleum pratensis*) into undisturbed areas can be facilitated by these linear disturbances. In addition, invasive weeds can alter the ecosystem’s natural processes and displace native, threatened, and endangered vegetation and habitat.

From an ecological function perspective, fragmentation affects those species that use forest habitats (aspen, white spruce, black spruce) extensively. However, certain species extensively use open habitats (graminoid fens and cleared areas such as seismic lines) in the boreal forest. For such species – for example, wood bison (*Bison bison athabascae*) – the forested elements of the landscape can present barriers to movement while herbaceous areas such as wellsites and seismic lines are typically utilized for grazing and movement (Gates et al. 2001). Thus, a fragmented landscape for species adapted to forest habitats may be a connected landscape for species utilizing herbaceous-dominated open habitats.

Fragmentation is measured in a number of ways. When viewing the landscape as a whole, the primary attributes of the undisturbed habitat (predominantly forest) that are quantified are class area, number of patches, average patch size, total edge, and total core area. Total core area is the portion of a forest stand that is located more than 100 metres from an edge. The question I wanted to answer in my research was this: “How do the metrics used to measure forest fragmentation differ between the traditional EA approach, where succession is not accounted for, and an approach that accounts for forest succession?”

The flow diagram shows the progression from an unvegetated disturbed stage, to the herbaceous stage, shrub stage, and pole sapling stage on linear disturbance. The structural stages are of interest. Herbaceous and shrub structural stages are barriers to movement for species that use interior forest habitats, or, conversely, are conduits for predators such as wolves.

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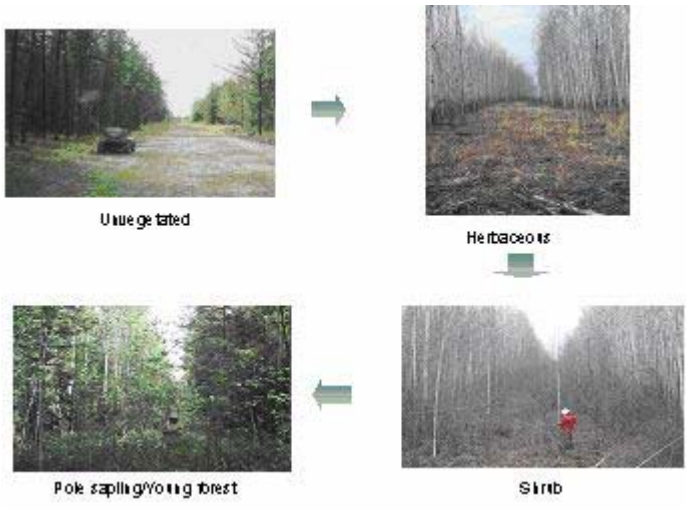

Pole sapling/young forest structural stages are comprised of densely-spaced trees that impede predator movement and human ATV use, and provide hiding cover for disturbance-sensitive wildlife species. Previously separated mature and old forest stands can be reconnected, re-establishing movement for species with lower tolerance for disturbance. One species that benefits from regeneration of seismic lines is the cat-sized member of the weasel family, the American marten (*Martes americana*). This species is a boreal forest resident that declines in abundance where forest is highly fragmented (Hargis and Bissonnette 1999). Regeneration of former barriers to movement (seismic lines) can increase useable habitat for marten and other interior species.

In this research, I measured structural stage regeneration at 30 locations along previously cut seismic lines in the boreal forest. Aerial photograph interpretation on large-scale, false-colour infrared photo-pairs also helped determine the structure of regeneration on lines with the following results.

The figure and results column on the left pertains to the traditional baseline landscape against which projects are assessed in EA. In this “cumulative-disturbance landscape,” all disturbance ever constructed is considered in the baseline. The figure and results column on the right shows a new approach where a “natural regeneration landscape” is used as baseline. In this landscape, regeneration on human disturbance reconnects many patches of the undisturbed forest (the matrix). In the “natural regeneration landscape,” relatively small areas of regeneration (two percent of total area) reconnected the undisturbed forest portion of the landscape.

The natural regeneration baseline landscape has a lower level of forest fragmentation compared to baseline measured traditionally. Compared to the traditional EA baseline, there is less edge habitat where weedy species typically occur and more core area that supports sensitive species such as American marten in the “natural regeneration landscape.”

To ensure that project effects are stated as accurately as possible in EA, assessment methodology, particularly GIS applications, can provide a closer representation of the actual landscape. The parameters needed to run these models (structural stages, site conditions) still need to be collected on regenerating disturbance in the boreal forest.

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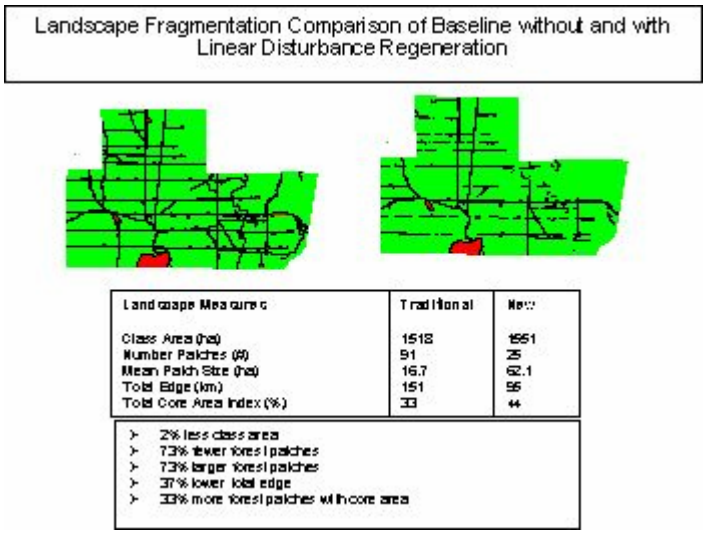

Forest succession on linear disturbance: The change in area of forest regenerated on clearings is 2% of total study area. Regeneration reconnects mature forest, reducing the total forest edge by 59%, increasing total core area by 33%.
Traditional – Cumulative Disturbance Landscape
New Approach – Natural Regeneration Landscape

References

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