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The understory story: variable retention impacts on vascular plants at EMEND

Highlights

- Vascular plants can serve as a valuable tool for understanding biodiversity responses to variable retention harvesting.
- Research at EMEND 2 and 8 years post-harvest suggests that vascular plants are impacted by harvesting, regardless of retention level, but stands with at least 20% retention more closely resemble intact forests.
- Machine corridors in partial-harvest systems resemble clear-cuts following harvesting, regardless of the retention level of the stand.
- Variable retention management prescriptions appear to have some potential benefit for conserving vascular plant communities, and may facilitate quicker recovery to pre-harvest conditions.

The Ecosystem Management Emulating Natural Disturbance (EMEND) Project is a multi-partner, collaborative forest research program. The EMEND project documents the response of ecological processes to experimentally-delivered variable retention and fire treatments. The research site is located in the western boreal forest near Peace River, Alberta, Canada, and is scheduled to last for an entire forest rotation (i.e., 80 years). Individual research projects evaluate which forest harvest and regenerative practices best maintain biotic communities, spatial patterns of forest structure, and functional ecosystem integrity, compared to mixedwood landscapes created by natural disturbances. Furthermore, economic and social analyses evaluate the long term viability and acceptability of these practices. This research note, part of a series about the EMEND Project, summarizes research on vascular plants in mixedwood forests.

Importance of vegetation

Forest managers seeking to evaluate management techniques require reliable, accurate methods for monitoring biodiversity. Understory vascular plants (forbs, graminoids, shrubs) are excellent subjects for understanding and evaluating biodiversity because they are known to respond to forest harvesting. For example, vascular plants respond directly to changes in light and microclimate conditions in the forest floor by shifting in species composition. Understory species also occupy a variety of ecological niches, so their response is representative of a range of ecological processes that may be impacted by forest harvesting. Vascular plants can therefore be used to understand the best ways to mitigate negative impacts of forest harvesting on biodiversity in boreal mixedwood forests.

This research note summarizes research conducted at EMEND looking at the effect of variable retention harvesting treatments on understory plant communities. The results will assist forest managers to understand the impacts of harvesting on understory vascular plants.

The EMEND project

The EMEND project used an experimental template where six levels of dispersed green-tree retention (0-2%, 10%, 20%, 50%, 75% and 100% or intact) were applied to whole forest stands 10 ha in size. These retention treatments were replicated 3 times over 4 dominant stand types (deciduous dominated canopy-primarily aspen and balsam poplar; deciduous canopy with developing understory of white spruce; mixed deciduous-conifer canopy; and conifer dominated canopy-primarily white spruce). Harvesting resembled a partial-cutting system whereby all machine traffic was concentrated along designated 5m wide machine corridors, separated by a 15m wide retention strip. Vascular plants were studied 2 and 8 years post-harvest, within both the retention strips and machine corridors.

Retention level influences plant composition

Short-term responses provide initial insight

A primary goal of research at EMEND is to compare the influence of variable retention harvesting on biodiversity, to that of other disturbances such as forest fire and clear-cutting. Early work at EMEND (2 years following harvest) revealed that variable retention harvesting, like clear-cutting, influences the understory plant community; however the extent of this impact is directly related to the amount of retention left on site. For example, two years after harvest clear-cut stands and 20% retention stands were statistically similar, while 75% retention stands were similar to intact forest stands. This finding was consistent across three stand types studied at EMEND (conifer dominated, mixedwood, deciduous dominated). The patterns were primarily driven by increases in shade-intolerant/weedy species and reductions in closed-forest species within the clear-cut and 20% retention sites.

These results provide a clear indication that some level of variable retention harvesting can have a reduced impact on the landscape compared to traditional clear-cutting practices. However, while these short-term results provide important baseline knowledge of variable retention impacts on understory plants, it is useful to look at longer term responses when considering possible threshold responses.

Over time, threshold responses to harvesting are clearer

Craig and Macdonald (2009) sampled the mixedwood stands at EMEND 8 years following harvest, and developed a series of relevant conclusions with respect to understory plant responses over time. They looked at changes in species composition, and found that clear-cut and 10% retention stands were similar to each other, while the 20%-75% stands were more similar to each other. All stands were different than the intact forest (Figure 1). The response within the clear-cut and 10% retention stands was driven by the presence of shade-intolerant/weedy species, such as *Calamagrostis canadensis* and *Epilobium angustifolium*; species that can negatively affect regeneration efforts. These results provide an initial indication that stands with at least 20% retention have a reduced impact on the understory vascular plant community, as compared to clearcut harvesting.

Through further analyses they determined that there was indeed a significant threshold response with respect to total understory plant cover and community composition. Stands that contained at least 20% retention were significantly different than the 10% retention and clear-cut stands (Figure 2). This pattern was again driven by increases in shade-intolerant/weedy species, primarily grasses such as *Calamagrostis canadensis*.

These results suggest that, from an ecological perspective, there appears to be value in variable retention harvesting that maintains at least 20% retention on site. This harvesting level has a lower impact on the understory plant community, results in fewer invasions by shade-intolerant/weedy species, and may facilitate faster recovery of biodiversity, when compared to traditional clear-cut harvesting. These studies also emphasize that short-term vegetation responses to harvesting, although informative, are

best augmented with longer-term results in order to fully understand vegetation responses to forest harvesting.

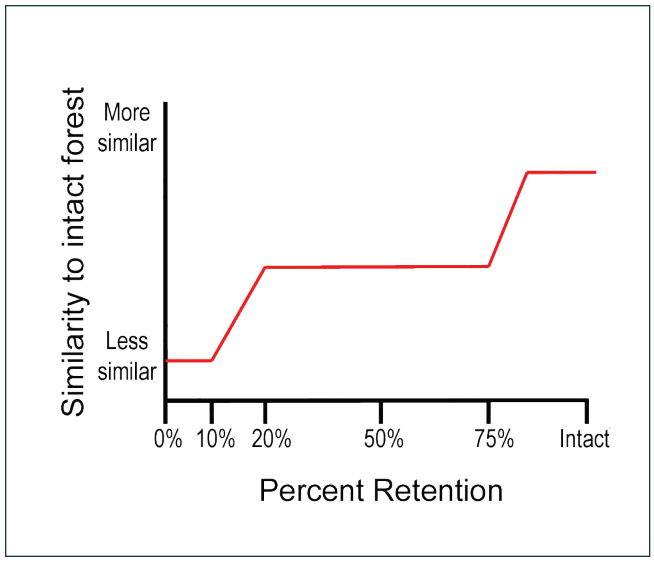

Figure 1. Threshold response of understory plants to variable retention harvesting at EMEND 8 years following harvest. Stands with at least 20% retention were more similar to the intact forest.

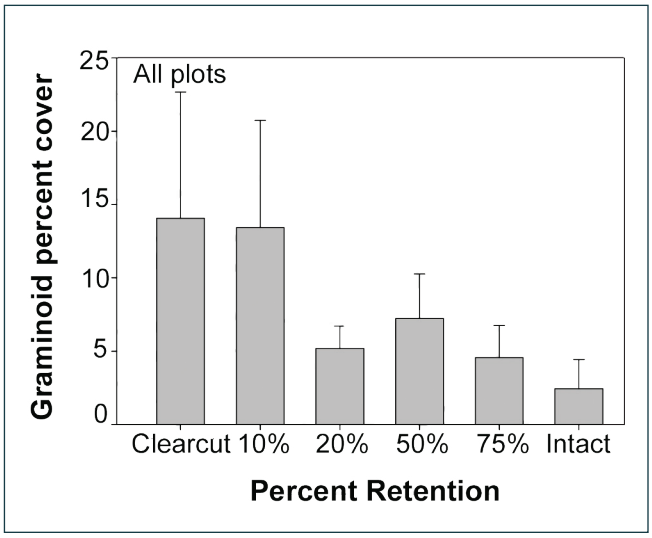

Figure 2. Total graminoid cover within variable retention harvest stands 8 years following harvest. Stands containing 20% or more retention were significantly different than the clearcut and 10% retention stands.

Machine corridors serve as small clear-cuts within stands

Because the impact of harvesting at EMEND was concentrated within the designated machine corridors, it is probable that the response of the understory plant communities may be different within these corridors than in the rest of the stand.

Research in the mixedwood stands at EMEND 8 years following harvest showed that understory plant cover and community composition in the machine corridors was similar to that in the clear-cuts, regardless of the retention level applied (i.e. 10%, 20%, 50%, 75%). Stands with 75% retention were, however, the most similar to control stands. These machine corridors were shown to facilitate growth of grassy and weedy species within the variable retention harvest blocks. Thus, machine corridors in partial harvest systems function as clear-cut strips within the harvested area. These results emphasize the impact that concentrated, heavy machine traffic can have on the recovery potential of understory plants within a stand.

Summary of findings to date from EMEND

Research to date on understory vascular plants at EMEND has produced meaningful results, and contributed to our understanding of the impacts of variable retention harvesting on biodiversity. From this work, two main conclusions can be drawn:

1) Variable retention harvests containing at least 20% retention appear to maintain vascular plant communities that are more similar to the intact forest. These results however are still relatively short-term (i.e. 8 years post-harvest) and thus additional monitoring should be conducted to better understand the long-term impacts of variable retention harvesting.
2) Heavy machine traffic within the machine corridors at EMEND had substantial impacts on the understory plant community, making them more similar to clear-cuts than the retention strips within the stand. This may, in turn, delay the recovery of plant communities within these corridors.

Further reading

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EMEND: http://www.emend.rr.ualberta.ca

Management Implications

- Variable retention harvests which maintain 20% or more of green-trees within blocks are likely to provide significant benefits to the understory vascular plant community.
- Managers should consider the value of supporting long-term studies to fully understand implications of harvesting practices on vegetative responses at various stages of stand development (i.e. stand age).
- Machine corridors were shown to create habitat that resembles a clear-cut. These areas may require additional management treatments to facilitate recovery of vegetative communities.

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Ecosystem Management Emulating Natural Disturbance

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