EMEND

ECOSYSTEM-BASED MANAGEMENT EMULATING NATURAL DISTURBANCE

EMEND Insights #17

Ecological Messages:

- Compared to dispersed retention, patch retention supported understory plant communities more similar to unharvested forest.
- Plant communities varied with patch size and location within the patch (edge or interior).
- Higher levels of dispersed retention surrounding retention patches benefit more sensitive shade-tolerant plants.

Management Implications:

- Combinations of dispersed and patch retention are recommended to promote tree regeneration in the harvested matrix while maintaining shade-tolerant species in the patches.
- Patches larger than 0.5 ha may be more effective in supporting plant communities typical of unharvested forest; even larger patches (e.g., >1 ha) should be further evaluated.
- Varying the level of dispersed retention of different sizes will most likely be the best strategy for conserving vascular plants with different habitat requirements.

Dispersed retention improves the conservation value of retention patches for plants

Research led by Caroline Franklin, Ellen Macdonald, and Scott Nielsen

There is more to the forest understory than meets the eye. These unassuming plants are an important part of forest biodiversity, being not only species-rich but also playing an important role in nutrient cycling and as food and habitat for wildlife. Practices like retention harvesting are believed to help conserve biodiversity by mimicking the structure of naturally-disturbed forest ecosystems—***but how does retention of overstory trees affect plants growing closer to the ground?***

Responses in understory plants to harvesting are in many ways well-understood. Some plants thrive after disturbance (e.g., early-successional and shade-intolerant species), while others are negatively affected by canopy tree removal (e.g., shade tolerant, interior forest dependent species). An important knowledge gap remains, however, when it comes to planning for the pattern and amount of retained trees. Retention patches are intended to lifeboat "old-forest" species, but what role do windthrow and other edge effects play in their effectiveness? If patches are relatively small (< 0.5 ha), do they have conservation value? We investigated responses of understory vascular plants to different retention patterns and levels 15 years post-harvest at EMEND.

Our study reveals that patch retention supports plant communities similar to unharvested forest, especially when surrounded by higher levels of dispersed retention (as compared to patches retained within clearcuts). Combinations of dispersed and patch retention are therefore recommended. While dispersed retention promotes aspen regeneration, patch retention supports some old-forest specialist species. Since different species respond differently to retention harvesting, we recommend varying both retention pattern and level across the landscape.

Most plant diversity is in the understory. Photo by S. Odsen.

Understory vegetation in forest ecosystems

Most plant diversity in the boreal forest is found beneath the trees, tucked away in the understory. Understory plant communities provide food and habitat for wildlife, play key roles in nutrient cycling, and affect tree regeneration. Forest harvesting alters plant communities: increased light allows shade-intolerant species like grasses and aspen saplings to thrive, with implications for forest succession following harvest. It is also important, however, to conserve the plant communities characteristic of unharvested forest on a managed landscape—in turn supporting the fauna that rely on them.

Patterns and levels of retention

Variable retention harvesting has been proposed as a method to conserve biodiversity and accelerate forest recovery, but managers must determine the amount and spatial pattern of retained live trees to leave within each cutblock.

Two common spatial patterns used in retention forestry are dispersed and patch retention. Retention patches provide canopy cover that should benefit shade-tolerant species characteristic of unharvested forest, if the residual trees are not quickly blown down. Surrounding retention patches with dispersed retention, instead of a clear-cut, could potentially benefit understory vegetation and thus be a useful harvesting option. In this study, we investigated the responses of understory vascular plants to different retention patterns and levels, 15 years after harvest.

Labrador tea (Ledum groenlandicum) grows in the shade of coniferous forests. Photo by S. Odsen.

Yarrow (Achillea millefolium) is a shade-intolerant plant common in harvested corridors. Photo by C. Franklin.

Study design

We sampled understory vascular plants at EMEND in the conifer- (white spruce) dominated compartments 15 years post-harvest. Treatments included clear-cut (2% retention), 10%, 20%, 50%, and 75% retention, as well as unharvested forest. We sampled at the edges and centres of small and large retention patches (0.20 ha and 0.46 ha, respectively) and at random locations in the surrounding dispersed retention.

Research questions

- How do retention pattern and patch size affect understory plant communities 15 years after harvest?
- Do edge effects or the surrounding level of retention affect the ability of patches to support understory plant communities typical of unharvested forest?

About EMEND:

The Ecosystem-based 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, with monitoring and research scheduled for an entire forest rotation (i.e. 80 years).

Key Findings

Dispersed and patch retention support different understory plant communities

When it comes to understory vegetation, dispersed and patch retention are not equivalent; rather, we found that they provide different (even complementary) benefits to understory vegetation.

Dispersed retention contained higher understory plant diversity than did patches. Light filtering through the harvested corridors at EMEND allowed more shade-intolerant species, including aspen and grasses, to grow. High levels of dispersed retention (50% and 75%) supported plant communities more similar to the unharvested forest.

Meanwhile, even the small retention patches in our study contained more shade-tolerant species typical of the unharvested forest. Unlike dispersed retention, we saw more of a "lifeboating" effect wherein older-forest species persisted within patches.

Understory vegetation differed between patch sizes and locations within patches

Variability in patch sizes will enhance conservation value of retention harvest for understory plants. ***Small (0.20 ha) and large (0.46 ha) patches at EMEND each supported distinct plant communities that contained different shade-tolerant species characteristic of unharvested forest.***

Grass cover was higher at the edges of large patches than in their centres, possibly due to higher windthrow and increased sunlight at patch edges. Otherwise, there were few differences in the understory plants between the edge and interior of retention patches. We attribute this to the fact that the patches were all less than 0.5 ha, meaning patch centres were less than 45 m from the edge. Consequently, edge effects on understory vegetation from the adjacent harvesting were present throughout these patches.

Higher levels of dispersed retention around patches benefits understory vegetation

Plant communities within patches had higher similarity to unharvested forest when there was higher dispersed retention surrounding the patch, illustrating the value of combining patch and dispersed retention patterns. The higher retention levels would have resulted in more shade, which favoured shade-tolerant species typical of the unharvested forest. Previous work at EMEND has also shown that windthrow rates were lower in patches surrounded with 20% or 50% retention (see EMEND Insights #12).

Lesser roundleaved orchid (Platanthera orbiculata) growing in the shade. Photo by C. Franklin.

Management Implications

Combinations of dispersed and patch retention are recommended to support plant community characteristics of both young and old forest. The dispersed retention area was characterized by an early-successional ecosystem, which plays a valuable role in the forest landscape by providing high plant diversity, productivity and forest regeneration. Meanwhile, patch retention helped maintain old-forest species, suggesting that the patches partly maintained the structural complexity and microclimatic conditions characteristic of unharvested stands.

Patches larger than 0.5 ha could potentially conserve shade-tolerant plants more effectively than the patches investigated in this study, being less susceptible to windthrow and edge effects. Nevertheless, our study reveals that even the small patches (0.20 ha) were beneficial for some shade-tolerant plant species characteristic of the unharvested forest, especially when surrounded by high retention levels. This interaction between dispersed retention level and patch size in terms of effects on understory plant communities should be considered in harvest design. Future studies should consider larger patch sizes as the patches at EMEND are very small.

Further reading

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