EMEND

ECOSYSTEM-BASED MANAGEMENT EMULATING NATURAL DISTURBANCE

EMEND Insights #12





Ecological Messages:

- Small retention patches (0.46 ha or less) of white spruce do not function well as lifeboats for saproxylic beetles associated with old forests when they are embedded within clear-cuts, but do retain many of these species when embedded within 20% and 50% dispersed retention harvests.
- Dispersed retention acts as a windbreak for retention patches as the forest regenerates around them, slowing windthrow and helping patches retain habitat characteristics of undisturbed forests.

Management Implications:

- Combinations of aggregated and dispersed retention improve the conservation benefits of small retention patches of white spruce for saproxylic species, although the long-term benefits are unclear.
- Large patches (>3 ha) are of high conservation value, but combining smaller patches with dispersed retention provides an option for conserving organisms that operate at small scales.

Dispersed retention improves the conservation value of small retention patches

Research led by Seung-Il Lee, John R. Spence, and David W. Langor

It is increasingly apparent that the thousands of species associated with deadwood ("saproxylic" organisms) comprise significant biodiversity in northern forests, where they play a critical role in ecosystem function. Regions in which extensive management has removed deadwood from forests (e.g., northern Europe) have incurred significant loss of forest biodiversity, especially among saproxylic organisms. Variable retention harvest is a tool proposed to counteract the processes driving such trends, by leaving live trees that will provide a continual source of deadwood within cutblocks.

Variable retention options include dispersed retention, where residual trees are scattered throughout a cutblock, and aggregated retention, where residual trees are grouped in patches. The conservation benefits of combining the two retention types have not been adequately researched until now. This study examines whether retention patches better conserve saproxylic beetles when surrounded by dispersed retention.

We collected saproxylic beetles from retention patches of white spruce embedded in clear-cuts and stands harvested to leave 20% and 50% dispersed retention, as well as from unharvested stands. There were clear benefits to combining dispersed and aggregated retention. Dispersed retention slowed windthrow within the retention patches, leaving considerably more live trees standing than in patches within clear-cuts. From a biodiversity perspective, beetle communities within retention patches surrounded by dispersed retention were much more similar to the communities characteristic of unharvested stands.

Dispersed retention improved the conservation benefit of small (<0.5 ha) retention patches for saproxylic beetles. This study is one of only two in the northern hemisphere examining the benefits of combining retention types. While the long-term benefit of these small patches remains untested, our results hold promise for this combined strategy as part of a forest manager's operational toolbox. ***Read on to find out more . . .***

Testing retention combinations for biodiversity benefits

Before employing variable retention harvest, one must decide whether to disperse residual trees throughout the cutblock, concentrate residual trees in patches, or combine these approaches. Each approach offers different potential benefits for biodiversity conservation. Dispersed retention improves deadwood distribution, and studies of ground-dwelling spiders and songbirds have shown overall positive responses to dispersed retention compared with clear-cutting. Aggregated retention maintains structural complexity and local microclimatic conditions similar to intact forests, and thus may provide a lifeboat for old forest specialists. However, studies on moths and saproxylic (deadwood-associated) beetles have shown that large retention patches (3–4 ha or larger) are needed to produce consistent biodiversity benefits when embedded within clear-cuts. This study considered the benefits of combining retention strategies.

Do retention patches better conserve saproxylic beetles when surrounded by dispersed retention?

A combination of dispersed and aggregated retention has been hypothesized as a better way to conserve biodiversity in harvested stands. Only one other study in the northern hemisphere (also at EMEND) has tested the benefits of combining these strategies. Our study puts this hypothesis to the test by examining ***how saproxylic beetles respond to combinations of dispersed and aggregated retention at EMEND.***

Why saproxylic beetles?

Saproxylic beetles use deadwood including snags, fallen trees, and coarse woody debris for shelter, foraging, and/or breeding. These organisms are important components of forest biodiversity and contribute significantly to ecosystem function; their reliance on deadwood and sensitivity to harvest make them important indicators of forest health. In northern Europe, saproxylic species have declined steeply in response to a history of extensive forest management and deadwood removal.

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).

We addressed this question by collecting beetles in 10-ha treated compartments in white spruce-dominated stands 10–11 years post-harvest at the EMEND project in northwestern Alberta. Each compartment contains one small (0.2 ha) and one large (0.46 ha) retention patch. Samples were collected using window and emergence traps in retention patches embedded in clear-cuts and in compartments with 20% and 50% dispersed retention, as well as in unharvested control compartments (Figure 1).

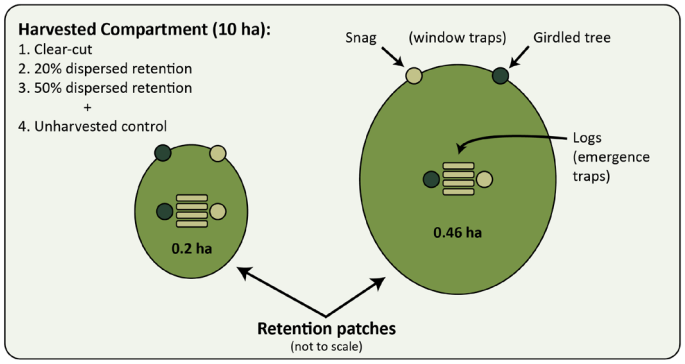

Figure 1. Locations of window and emergence traps for sampling saproxylic beetles. Window traps were placed at the centres and outside edges of each retention patch. Emergence traps were installed on four logs at the centre of each patch.

Main findings

Dispersed retention reduces windthrow within patches

Combining retention types reduced rate of windthrow, which is one of the biggest challenges to variable retention harvest. One of the goals of variable retention harvest is to maintain merchantable live trees and a long-term supply of deadwood as residual trees gradually die off. This goal cannot be achieved if all the trees blow down in the first 10 years.

There was severe windthrow in retention patches within clear-cuts, which had substantially fewer live trees than the patches within dispersed retention (Figure 2a)—one small patch in a clear-cut, for example, had only nine trees still standing. As a result, patches in clear-cuts had two to three times the volume of downed coarse woody debris than patches embedded within dispersed retention (Figure 2b). Fewer trees survived in the small patches (0.2 ha) than the large patches (0.46 ha), but only in the stands with dispersed retention. ***Interestingly, when the amount of dispersed retention increased from 20% to 50%, no additive benefit was observed in terms of the number of live trees remaining in patches.***

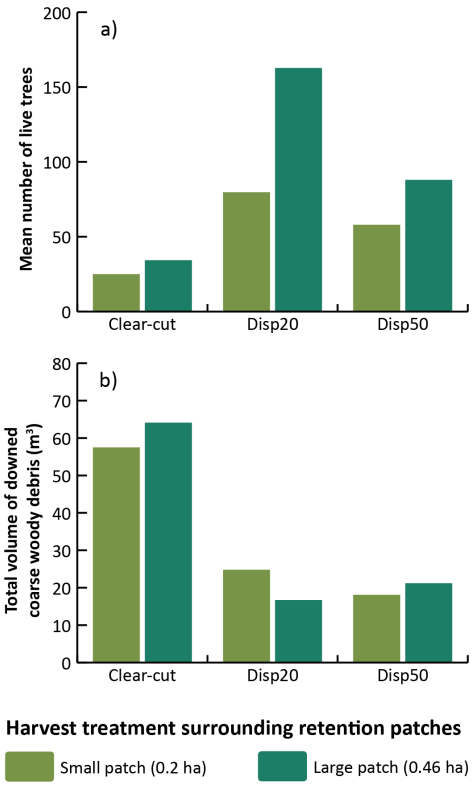

Figure 2. Retention patches surrounded by dispersed retention (Disp20 and Disp50) had a) more live trees and b) less downed coarse woody debris, on average, than patches in clear-cuts.

Figure 3. Saproxylic beetles collected from retention patches surrounded by dispersed retention (Disp20 and Disp50) generally had high similarity with the species collected from unharvested forest (Control), while patches surrounded by clear-cuts had little to no similarity.

Old-forest species are better conserved in patches surrounded by dispersed retention

We measured conservation effectiveness by comparing species composition of samples caught within patches against those caught in the unharvested controls. ***The rationale for comparing patches to unharvested controls was to test the ability of patches to serve as life-boats for old forest species known to be most susceptible to forestry practices.*** Where species composition was similar, we inferred that retention patches were more effective lifeboats for beetle species that rely on old-forest habitats.

These relatively small (<0.5 ha) retention patches were most effective for conserving saproxylic beetles when they were surrounded by dispersed retention. Saproxylic beetle assemblages collected in patches within clear-cuts had low similarity to those found in unharvested stands. In contrast, there was higher similarity in species composition between patches embedded in dispersed retention and unharvested stands (Figure 3).

As with the amount of windthrow, we did not observe an additive benefit of 50% retention for saproxylic beetles—the degree of similarity between the 20% and 50% retention treatments was high. This result suggests that, under a combined retention approach, increasing dispersed retention from 20% to 50% will not incrementally benefit saproxylic beetles in retention patches. ***If residual volumes >20% are to be maintained within the compartment, they may be more effectively allocated to form aggregated retention patches.***

Management Implications

This study clearly demonstrates that ***dispersed retention improves the conservation benefits of relatively small (<0.5 ha) retention patches of white spruce within cutblocks in the first 10 years of forest regeneration.*** Dispersed retention treatments of 20% and 50% slowed windthrow within patches relative to clear-cuts, and better maintained saproxylic beetle communities characteristic of unharvested forest.

Concurrent work found that patches >3 ha in size embedded in clear-cuts are more effective than smaller patches for conserving saproxylic beetles (see EMEND Insights #9). The results presented here suggest that dispersed retention is an excellent option for improving the value of smaller patches for old-forest species, but it remains to be seen whether these small patches will continue to resist windthrow in the long term.

Combining retention strategies shows promise as a valuable tool for forest management to increase complexity at the stand- and landscape-scale. Our results suggest that managers may gain conservation advantages by combining dispersed and aggregated retention.

Suggested Reading

Lee, S.-I., Spence, J.R., and Langor, D.W., 2017. Combinations of aggregated and dispersed retention improve conservation of saproxylic beetles in boreal white spruce stands. Forest Ecology and Management, 385: 116–126.

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Pinzon, J., Spence, J.R., and Langor, D.W., 2012. Responses of ground-dwelling spiders (Araneae) to variable retention harvesting practices in the boreal forest. Forest Ecology and Management, 266: 42–53.

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