EMEND





ECOSYSTEM-BASED MANAGEMENT EMULATING NATURAL DISTURBANCE

EMEND Insights #4

Ecological Messages:

- Moths are generally more susceptible to the loss of mature forest than other species and may require specific conservation strategies that focus on preservation of mature forest patches.
- Specialist moth species might be especially vulnerable to forest harvesting and may require greater attention in terms of which habitats are conserved.

Management Implications:

- Intact boreal forests are home to a considerably higher number of moths than a similar sized harvest block.
- While mature forest is required for most moth species, relatively large conifer retention patches were shown to maintain local moth populations and species diversity.
- Specialist moth species are more sensitive to loss of mature forest and may require a greater focus on retaining patches that contain deciduous woody plant species.

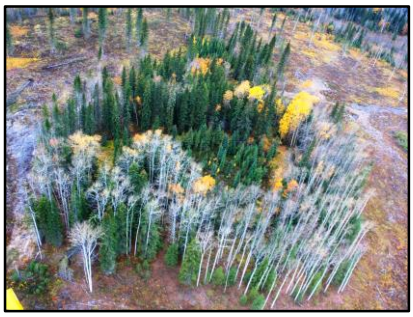
Large retention patches support moth biodiversity

By Brett Bodeux and Fangliang He

While moths may not be the first things that come to mind when you think about biodiversity, their abundance and importance in the boreal forest is impressive. A total of 776 macromoth species can be found within the boreal forest of Alberta, and their functions range from pollinators, to consuming plants, to serving as food for other components of biodiversity (e.g., birds). Moths are also strongly associated with mature forests and, therefore, the loss and fragmentation of boreal forest caused by forest harvesting is of concern for these species. However, the use of aggregated green tree retention within harvest blocks may be a way of reducing the impacts on moth species.

In this study, we set out to determine the relative impacts of forest harvesting on boreal moth species, and evaluate the potential benefits of aggregated green tree retention within conifer harvests. We sampled a large scale (~400 ha) coniferous harvest block and compared the spatial patterns of moth diversity to a similar sized (~400 ha) intact area of boreal forest. Patch sizes within the conifer harvest block ranged from 0.13 ha to 5.07 ha.

The results from our study showed that an area of intact boreal forest supports a considerably higher number of moths than a similar sized area of boreal forest with aggregated green tree retention harvesting. However, large patches of aggregated green tree retention (i.e. those with an area of ~ 4 ha or greater), provided suitable habitats for the maintenance of viable moth populations and greater biodiversity. We also found that fewer 'specialist' moth species occupy a harvested forest even with aggregated green tree retention, which is likely related to a reduction in the number of deciduous woody plants within these sites. ***Read on to find out more. . .***



Aggregated (top) vs dispersed (bottom) retention harvests. Photo credit: DMI.

The Context

Forest Harvesting and Biodiversity

Conserving biodiversity is a cornerstone of sustainable forest management. As such, current forest management practices provide a much greater focus on non-timber values, than historical practices. However, the effects of forest harvesting on biodiversity can be complex and difficult to evaluate. For example, populations of many boreal forest species are highly dependent on the availability of mature forest habitat and they are intolerant of widespread habitat loss. Thus, habitat loss and fragmentation associated with forest harvesting represents a serious threat to some species and it is critical to evaluate and understand these effects in order to develop effective conservation strategies.

Importance of Moths to Boreal Forest Biodiversity

With some 776 macromoth species known to occur within the boreal forest of Alberta, moths represent a substantial component of boreal forest biodiversity. Ecologically, moths play important roles as pollinators, herbivores and as food to many different types of species in the boreal forest. Therefore, moths are extremely diverse and represent critical components of boreal forest biodiversity.

The loss and fragmentation of boreal forest caused by forest harvesting is particularly concerning to moths as they are strongly associated with high mature forest cover. In particular, moth species with larvae that feed on woody plants tend to exhibit the strongest response to loss in mature forest habitats. This suggests that moths with specific feeding preferences might be especially vulnerable to forest harvesting and may require greater attention in terms of conservation strategies. Overall, understanding the impacts of forest harvesting practices on moth species is critical for maintaining boreal forest biodiversity and provides substantial contributions towards the development of successful strategies for sustainable forest management.

Promoting Biodiversity Through Green Tree Retention

Green tree retention, where live trees are left standing within a harvested site, is a frequently used forest management strategy to promote the conservation of biodiversity. Often, live trees are left in clumps commonly referred to as aggregated green tree retention. The two main roles of aggregated green tree retention for conserving biodiversity are: 1) 'life-boating' species within the harvested forest matrix; and 2) providing 'stepping stones' that promote dispersal of individuals throughout a fragmented landscape. However, the efficacy of aggregated green tree retention at achieving these roles is not well understood.

To determine the overall impacts of mature forest loss on boreal forest moth species, and to evaluate the potential benefits of aggregated green tree retention, we designed an experiment whereby we sampled a large scale (~400 ha) coniferous harvest block and compared the spatial patterns of moth diversity to a similar sized (~400 ha) intact area of boreal forest. Conifer patch sizes sampled within the harvest block ranged from 0.13 ha to 5.07 ha, and additional light traps were set up directly within the harvested forest area as well as in the immediately adjacent intact forest. All moths were collected using light traps.

Over the duration of our study we collected 235 different macromoth species. A total of 6,671 individuals belonging to 181 species were sampled from the intact forest while only 3,326 individuals belonging to 153 species were sampled from the harvested forest with aggregated green tree retention.

The author collecting moths from a light trap at EMEND.

Research Findings

Changes in Moth Biodiversity Associated with Forest Harvesting

The results from our study showed that an intact area of boreal forest supports a considerably higher number of moths than a similar sized area of boreal forest with aggregated green tree retention harvesting, regardless of spatial scale. Additionally, within the conifer harvest site, patch size played the dominant role in determining the number of moths and moth species that were sampled at a given light trap location. Large patches of aggregated green tree retention (i.e. those with an area of ~ 4 ha or greater), therefore, provided more suitable habitats for the maintenance of viable moth populations and greater biodiversity. **In fact, our analyses indicated that the primary factor restricting the distribution of moths within the harvested site was the size of aggregated green tree retention patches.** Our results also suggested that individual moths were capable of dispersing to mature forest habitats throughout the harvested forest site, as long as the necessary habitat was available to them.

Specialist Moth Species Require Additional Planning

Within relatively large patches of aggregated green tree retention our study revealed that the composition of moth species showed a high similarity to adjacent areas of intact forest. However, comparisons of the spatial patterns of moth diversity indicated that **moth species with larvae that feed on very specific host plants exhibited a particularly negative response to forest harvesting.** Fewer of these 'specialist' moth species occupy a harvested forest with aggregated green tree retention, which is likely related to a reduction in the number of deciduous woody plants. Habitat loss was shown to be especially concerning for 'specialist' moth species. **Thus, without knowledge of plant species composition within the patches of aggregated green tree retention, the benefits for promoting the conservation of 'specialist' moth species is uncertain.**

Aggregated retention within an industrial harvest. Photo courtesy of DMI.

Management Implications

- The availability of mature boreal forest habitat is essential for the conservation of moth biodiversity and relatively large patches of aggregated green tree retention are particularly beneficial for maintaining local moth populations and species diversity.
- Moths are generally quite capable of colonizing patches of aggregated green tree retention within a harvested forest and can achieve similar levels of biodiversity to intact forest habitats within relatively large sized patches.
- Specialist moth species are especially susceptible to the loss of mature forest habitat and may require a greater focus on the composition of woody plant species that are retained in patches of aggregated green tree retention.

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).

Further Reading

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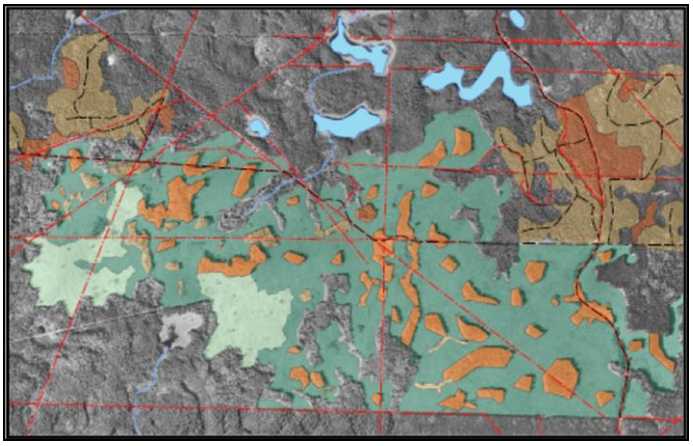

A map of the study site. Orange indicates retention patches, green indicates harvesting.

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