



## ECOSYSTEM-BASED MANAGEMENT EMULATING NATURAL DISTURBANCE

EMEND Insights #6

### Ecological Messages:

- Impacts of harvesting on birds was strongest in the first two years post-harvest, and partial retention significantly reduced these impacts compared with clear-cuts.
- The presence of edge and open-area specialists in the 10 ha unharvested stands suggested these stands were vulnerable to edge effects.

### Management Implications:

- Partial retention harvesting is better than clear-cutting at retaining bird communities that more closely resemble those found in an unharvested landscape.
- Mature forest reserves must be large in size. Even ten-hectare unharvested stands were subject to edge effects from adjacent harvested stands.
- Varying retention levels across the landscape and leaving unharvested reserves will provide habitat for more songbird species while maintaining mature forest specialists.



Photo: Gerald Romanchuk

## The role of retention and reserves in the conservation of forest bird communities

By Sonya Odsen, John Spence and Fiona Schmiegelow

The boreal forest provides breeding habitat for over 300 bird species, earning it the nickname “North America’s Bird Nursery.” Given the worrisome declines of many bird populations over the past four decades, it is vital to determine how industrial activity in the boreal forest affects breeding bird communities, and how these effects might be mitigated. Partial retention harvest, where a pre-determined number of live trees are left on the landscape, has been proposed as a conservation-friendly alternative to traditional clear-cut harvesting.

We investigated boreal songbird community responses in ~10 ha compartments harvested to five experimental retention levels (clear-cut (2%), 10%, 20%, 50%, and 75%) as well as unharvested stands, over a 16-year period. Bird surveys were conducted one year before harvest, and compartments were re-surveyed 1-2, 7-8, and 14-15 years after harvest.

Songbird communities showed two major responses: stand-level and landscape-level effects. At the stand level, partial retention of any amount clearly reduced the impacts of harvesting. Bird communities in partial retention stands were more similar to those in the unharvested stands, while communities in the clear-cuts differed significantly. At the landscape level, application of harvest across the study area resulted in an overall species richness increase after seven years. Additionally, 10 ha unharvested stands were subject to edge effect, as even these uncut areas supported edge and open-area specialists after the EMEND harvests were applied.

The results of this study provide support for partial retention harvest as a better method than clear-cutting for conserving mature forest associated birds, but do not reveal a ‘silver bullet’ solution for forest managers. Rather, the results highlight the importance of heterogeneous harvest plans. That is, forestry that uses different retention levels (including clear-cuts) across the landscape leads to a greater diversity of songbird species and avian communities than harvesting to a single retention level. In addition, the evidence of edge effect in the unharvested stands emphasizes the importance of maintaining reserves > 10 ha within the boreal landscape in order to maintain intact mature forest communities.

## The Context

Significant global declines of many bird species have been observed since the 1970s, prompting intense research around bird populations and factors contributing to their declines. While interior forest birds in Canada have not declined drastically, unlike other groups such as shorebirds, they represent a significant component of the biodiversity in Canada's boreal forest. Billions of birds from over 300 species breed in the boreal forest every year, and the increasing footprint of industrial activity in the boreal forest is often thought to present a threat to these populations.

Human disturbance, specifically clear-cut harvesting, has the potential to impact breeding bird populations in a number of ways. Removal of mature, large-diameter trees reduces the number of nesting sites available for canopy- and cavity-nesters, and exposure of the ground and the associated changes in vegetation have negative implications for ground-nesters. Canopy removal additionally changes the type and quantity of food (e.g., seeds and insects) available for foraging birds, and nests may be more vulnerable to predation.

In addition to the short-term impacts of clear-cutting, regenerating stands also represent altered breeding habitat. The boreal forest has been historically dominated by wildfire, which retains structural 'legacies' including unburned fire skips, standing dead trees (snags), and downed woody material. These legacies retain mature forest patches and maintain the structural complexity and uneven-aged structure of regenerating stands. This contrasts sharply with clear-cuts, which regenerate to more-or-less even-aged stands and are often managed as monocultures. Second growth stands may also frequently be re-harvested before old-growth characteristics such as large-diameter, decaying trees and snags re-appear.

If clear-cutting is maintained as the dominant harvesting technique across the Canadian boreal forest, this has implications for breeding bird populations as uneven-aged and mature forests are replaced with young, even-aged harvests.

This study examines the use of partial retention harvest as a conservation tool by testing whether it reduces the impacts of harvesting on songbird communities in the boreal 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).

## Study Design

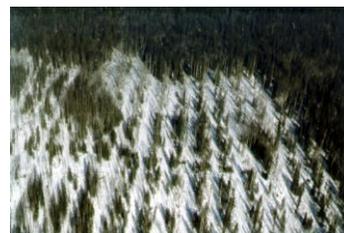
Clear-cuts (2% retention), 10%, 20%, 50%, and 75% retention treatments were tested across four tree cover types, ranging from aspen- (*Populus tremuloides*) to spruce- (*Picea glauca*) dominated stands. This study uses bird survey data collected at EMEND in 1998 (one year before harvest), 1999-2000, 2005-2006, and 2012-2013.



Clear cut



10% retention



20% retention



50% retention



75% retention

## Research Questions

- 1) How does partial retention harvest affect breeding songbird communities in the boreal mixedwood of Alberta, relative to clear-cuts and unharvested stands?
- 2) What is the effect of partial retention harvest on the recovery of songbird communities to their pre-harvest state?

## Research Findings

### *Partial retention reduced the impacts on boreal songbirds in the short term*

Although clear-cutting led to a significant decrease in the number of bird species in the short term ( $\leq 2$  years), as little as 10% partial retention substantially reduced this decline (Figure 1), suggesting that partial retention moderated the impacts of harvesting. Changes to the number of species were not linear, however. After seven years, the number of species increased beyond pre-harvest levels in all treatments (including unharvested stands), but after 15 years, the number of species dropped to levels more closely matching pre-harvest richness.

When bird communities (i.e., the abundance, richness, and identity of the species) were analysed and compared, the pattern was somewhat similar. In the short term, bird communities in the clear-cuts differed dramatically from those in the unharvested stands, and partial retention was valuable in buffering against the immediate changes caused by harvesting. After fifteen years, the differences between communities in the clear-cuts, partial retention stands, and unharvested stands were much smaller.

**These results suggest the benefits of retention harvesting were most evident in the first decade after harvest.** Convergence in the number of species and in bird communities after 15 years also indicates some degree of community 'recovery' over this time period. While increased retention mitigated the impacts of harvesting relative to clear-cutting, it does not appear to have accelerated community recovery.

**In addition, the large increase in the number of species after seven years suggests the impact of landscape-level effects. The conversion of a large, continuous, mature forest to a mosaic of uncut, partially cut, and regenerating clear-cut stands provided a variety of different habitats.** After seven years of regeneration, this habitat mosaic was able to support more species than were observed prior to harvest (1998).



Photo: Gerald Romanchuk

### *Unharvested stands maintained mature forest associated species, but were subject to edge effect*

Ten-hectare unharvested stands were maintained across the EMEND experiment, and they had a higher number of species seven years after harvest. **While none of the species originally observed in 1998 were lost from the landscape, the increased number of species indicates that 10 ha patches of mature forest were susceptible to edge effects.** Birds are highly mobile, and can easily move between a mature forest patch and adjacent cutblocks, or inhabit transition habitats. This presence of additional species may negatively impact the reproductive success of mature forest specialists as they face increased competition for nesting sites and food resources. **Thus, for unharvested forest patches to be effective for species that require intact forests, our results suggest that these patches must be larger than 10 ha in size.**

## Management Implications

Partial retention successfully reduced the impacts of harvest on boreal breeding songbird communities compared with the impacts of clear-cutting. **While partial retention proves to be a promising tool for buffering species composition change, particularly in the first decade after harvest, there is no “threshold” retention level that maintains communities as they existed before harvest.**

**Rather, these results suggest the importance of heterogeneous harvest plans to provide habitats for a variety of different bird species while maintaining mature forest communities on the landscape.** We argue that harvest plans should include some reserves or “set-asides” > 10 ha to provide significant areas without edge effects as a precaution aimed at facilitating landscape level recovery of mature forest birds. Just as a variety of bird communities would be found across a post-fire landscape, so too should a variety of communities be a goal of sustainable forest management.

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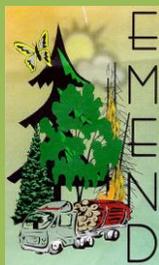
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## ECOSYSTEM-BASED MANAGEMENT EMULATING NATURAL DISTURBANCE



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