

Investigating Boreal Songbird Communities Amid Variable Retention Harvesting in Deciduous and Mixedwood Forests

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AUBIO 315 - Advanced Biological Analysis

Introduction

Forestry, an anthropogenic disturbance, alters tree stand composition, impacting songbird communities.^{1,2} Retaining canopy cover may allow more bird species to occupy an area by providing diverse vegetation and varying niches.³

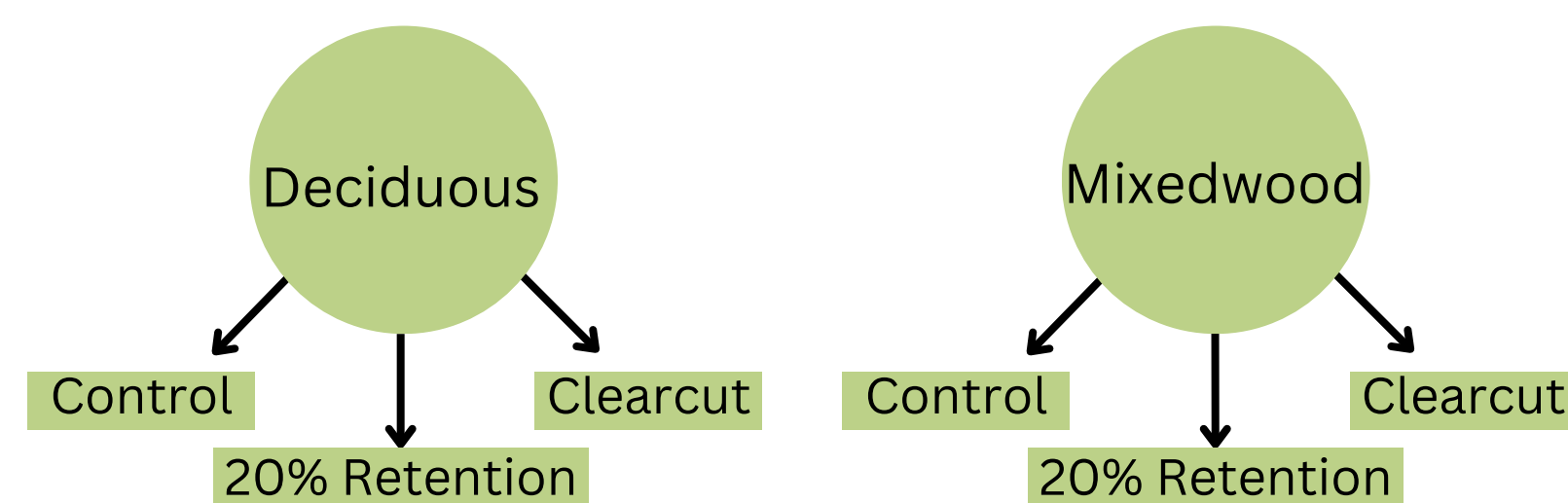
Objective

- Investigate the effects of harvest treatment on songbird community composition in boreal forest habitats.

Hypotheses

- If variable retention harvesting affects songbird communities, we expect differences between treatment levels, with clear cut having the largest difference in songbird diversity due to the substantial decrease in vegetation.
- If boreal forest type affects songbird community composition, we expect differences between deciduous and mixed wood stands due to differences in vegetation type (niche availability).

Methods



- Completely randomized with 3 replicate blocks per forest type.
- 5 minute listening surveys, conducted five years post-treatment.
- Analyses: NMDS visualization, perMANOVA, indicator species analysis, two-way ANOVA, and a Kruskal-Wallis test (R and JASP softwares).

Results

Community Composition perMANOVA

- Evidence strongly suggests a significant difference in songbird communities among boreal forest types (pseudo $F_{(1,17)}=3.60$, $p=0.0025$).
- Evidence strongly suggests a significant difference in songbird communities among harvest treatments (pseudo $F_{(2,17)}=2.97$, $p=0.0012$).
- Evidence moderately suggests a significant interactive effect of boreal forest type and harvest treatment on songbird community composition (pseudo $F_{(2,17)}=1.89$, $p=0.019$).

Boreal Songbird Communities Show Varied Local Diversity Based On Forest Type and Variable Retention Harvesting Techniques

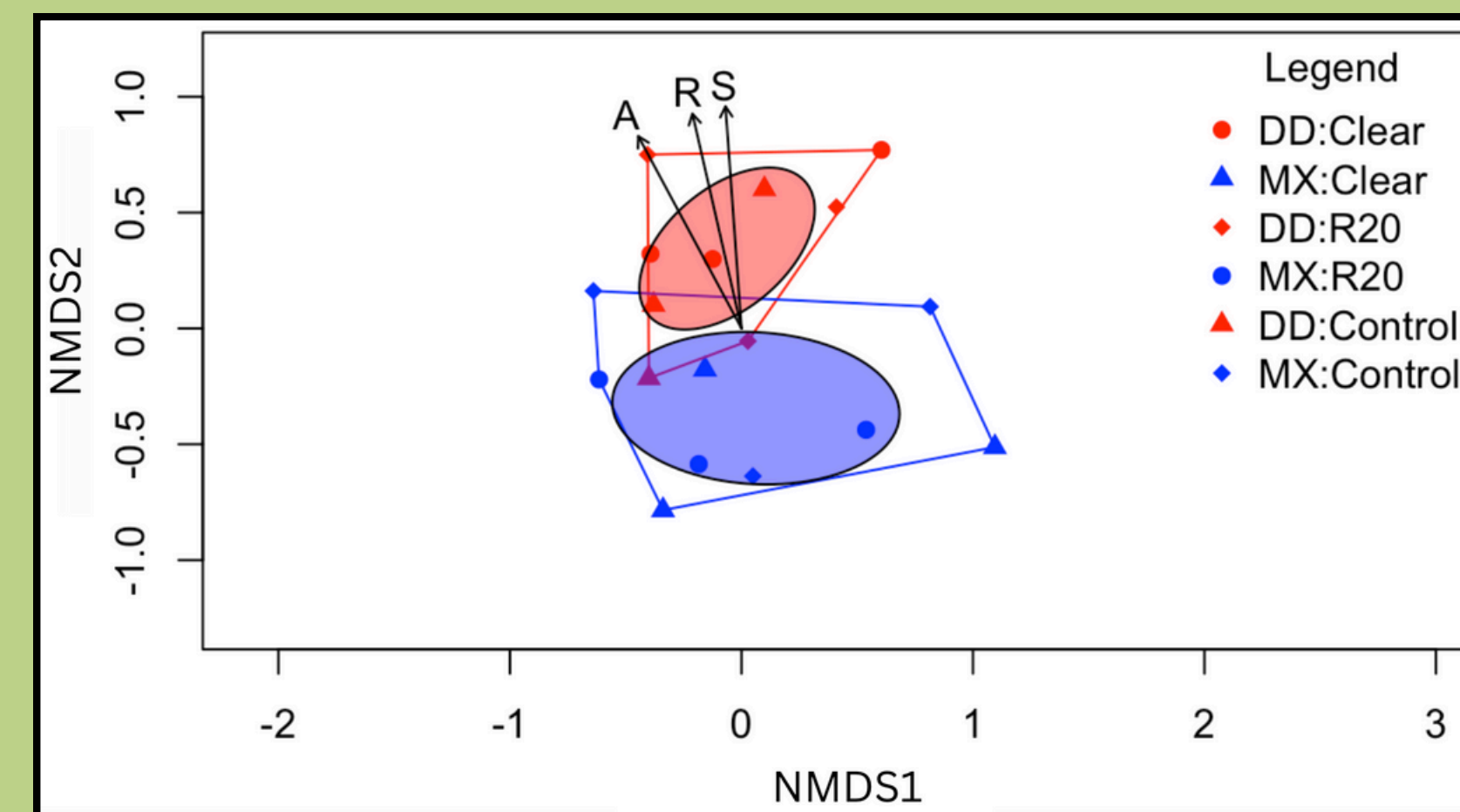
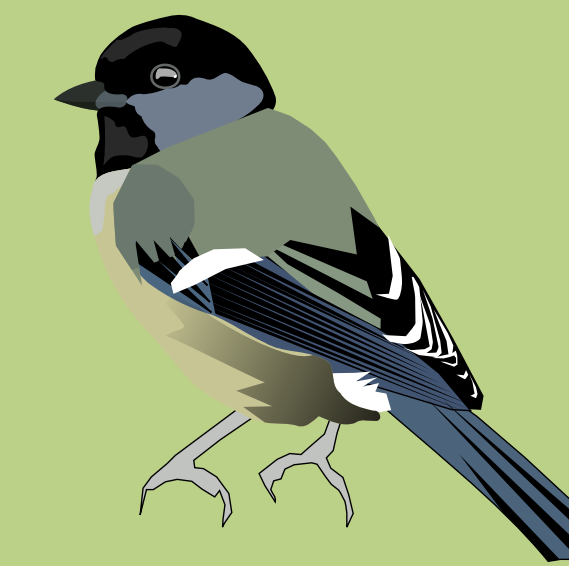


Figure 1. NMDS Ordination plot of Boreal songbird community response to clear cut, 20% retention, and control harvesting in deciduous and mixedwood forests stands. “A” indicates abundance, “R” indicates richness, and “S” indicates Shannon Diversity.

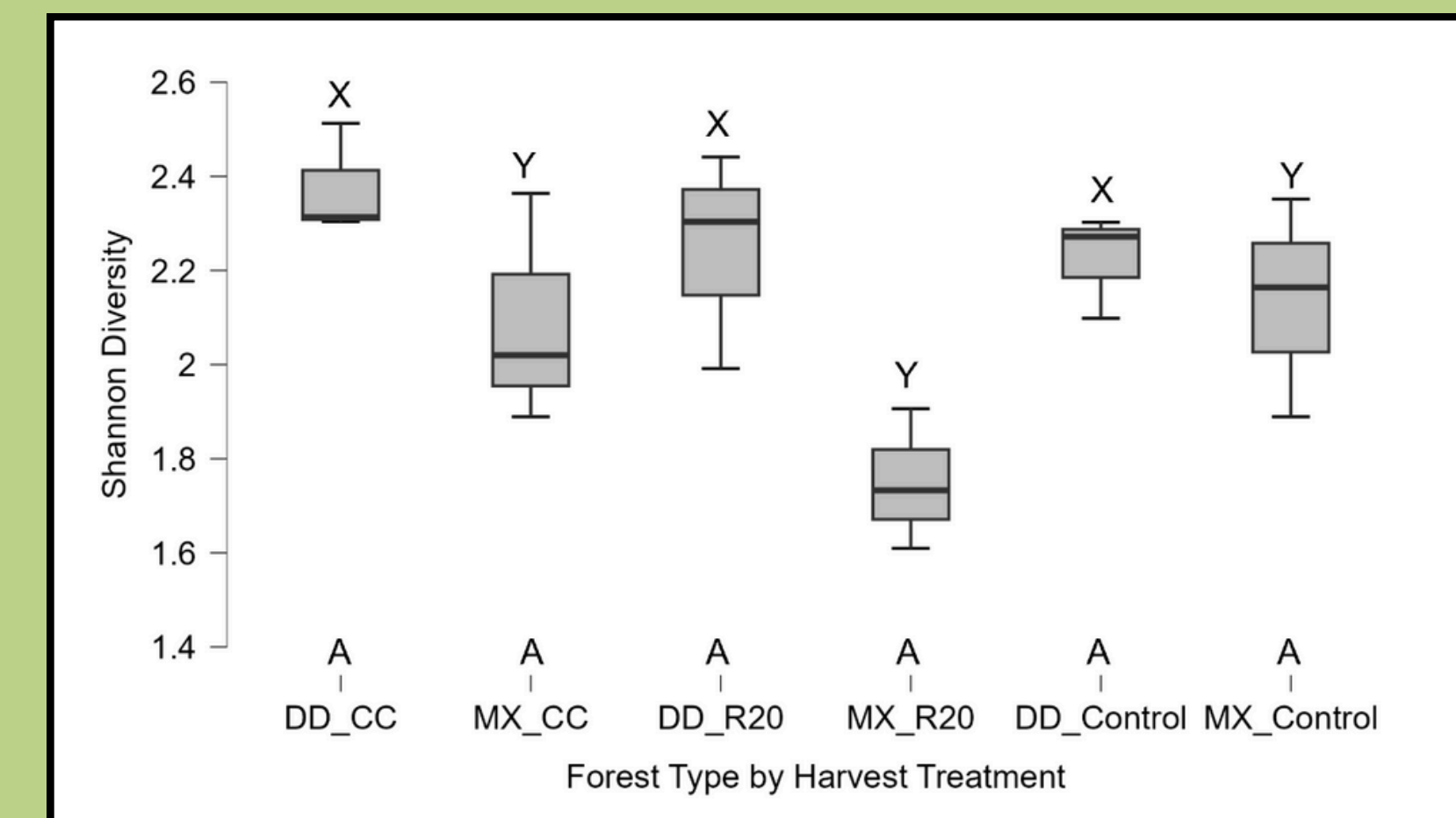


Figure 2. Boxplots of songbird community Shannon Diversity dependent on combined factors of forest type and treatment. Different letters indicate significant difference (above: forest type; below: treatment).

- Evidence strongly suggests a significant difference in songbird communities between clearcut stands and controls (post-hoc Bonf. $p=0.006$).
- Evidence does not suggest a significant difference in songbird communities between control and 20% retention stands (post-hoc Bonf. $p=0.057$), nor between 20% retention and clearcut (post-hoc Bonf. $p=1.00$).

Indicator Species Analysis

- Evidence strongly suggests that the Canada Warbler (*Cardellina canadensis*) was an indicator species in the deciduous control stand.
- Evidence strongly suggests that the Golden-crowned Kinglet (*Regulus satrapa*) was an indicator species in the mixed wood control stand.
- Both of these species ranked a 1 in specificity and sensitivity using a multilevel pattern analysis.

Mean Shannon Diversity Two-way ANOVA

- Evidence does not suggest a significant difference among harvest treatments (Fig. 2, $F_{(2,12)}=2.559$, $p=0.119$, $\eta_p^2=0.299$).
- Evidence strongly suggests a significant difference among boreal forest types (Fig. 2, $F_{(1,12)}=10.547$, $p=0.007$, $\eta_p^2=0.468$).
- Evidence does not suggest a significant interaction between harvest treatment and boreal forest type (Fig. 2, $F_{(2,12)}=1.725$, $p=0.219$, $\eta_p^2=0.223$).

Discussion

Community Composition and Species Richness

- Results support the hypothesis that harvest level and forest type affect songbird community composition.
- Similar to other studies, our results show a reduction in species richness/diversity shortly post-harvest in boreal forests.^{4,5}

Limitations

- PerMANOVA: significant forest type and harvest treatment interaction on songbird communities. Post-hoc hindered by R software errors. 15 pairwise comparisons made interactions insignificant.

Indicator Species

- Indicator species analysis is supported by *C. canadensis*'s and *R. satrapa*'s displayed habitat preferences for old-growth forests.^{6,7}

Future Directions

- Investigate the long-term effects of harvesting techniques on different forest vegetation types for a comprehensive understanding of anthropogenic impacts on songbird communities.



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