Microclimate and Plant Community Changes Across Forest Edges Created by Clear-cutting

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Introduction

❑Forest management techniques that involve clear-cut logging can create fragmented landscapes

❑ These landscapes may contain patches of forest at different successional stages

❑The edges that border these distinct patches exhibit both abiotic and biotic gradients across their length (edge effects)

❑ This study quantified microclimate and plant communities changes across edges created by patch clear-cutting in maple-beech-birch forest in the Adirondack Mountains, NY (Figure 1)

❑ To better understand how edge effects vary over successional time, we studied edges bordered by mature forest and cut-over areas that were cleared at different times (5 and 15 years prior to sampling)

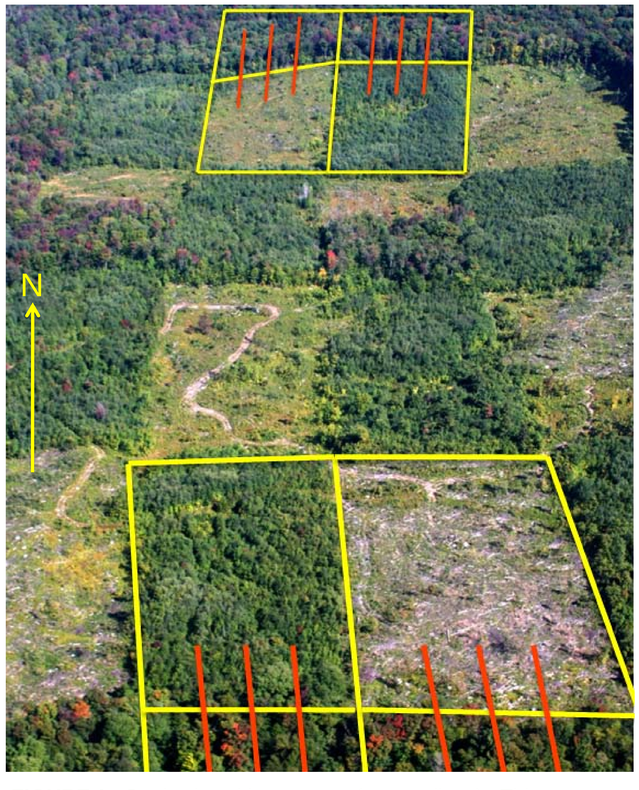

FIGURE 1. Study site with transects (orange lines). This area of the Huntington Wildlife Forest was cut in a checkerboard pattern with alternating blocks of younger and older clear-cuts. Original photo by Bruce Breitmeyer.

Methods

Four edges in the Huntington Wildlife Forest near Newcomb, NY were selected for study. Two of the edges were 5 years old, and two were 15 years old. We measured percent open sky, air temperature, soil moisture, and cover of ground-layer plants along 60 m long transects (3 per edge) (Figure 2). Plant community sampling took place within plots positioned at increasing distances at both sides of the forest edge.

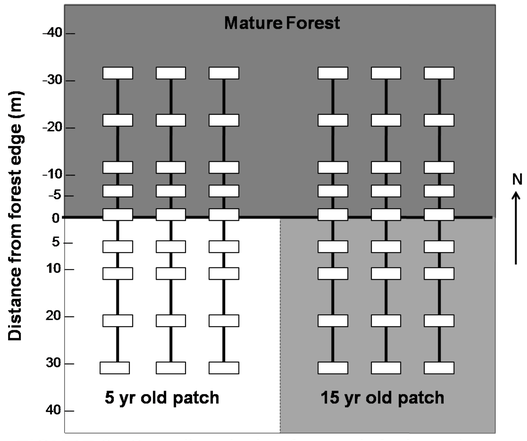

FIGURE 2. Sampling design for south-facing edges (topmost edges in Figure 1). North-facing edges were sampled in an identical fashion. The transects were at least 12 m apart from each other and at least 25 m from the neighboring clear-cut. The white rectangles represent three 1 × 1 m subplots spaced 1 m apart.

Percent open sky was measured with a convex spherical densiometer. Air temperatures were recorded hourly with data loggers (iButtons) for 32 days between July and August 2008. From this temperature data, we calculated season averages for daily mean, minimum, and maximum temperature and for the daily temperature range. Volumetric soil moisture content was measured using a soil moisture probe (Hydrosense®). Plant cover was recorded for individual ground-layer vascular species (or genera in some cases), all vascular plants pooled, and all bryophytes pooled. Spatial gradients across edges of different age and "treatment-level" averages were compared using *Tukey* HSD tests.

Results

❑ Percent open sky, maximum temperature (Figure 3), all other air temperature variables (data not shown), and total plant cover (Figure 4) exhibited steep spatial gradients across the 5 year old edges.

❑None of these variables showed gradients across the 15 year old edges (c.f. Figures 3, 4).

❑Soil moisture showed no edge gradients at all.

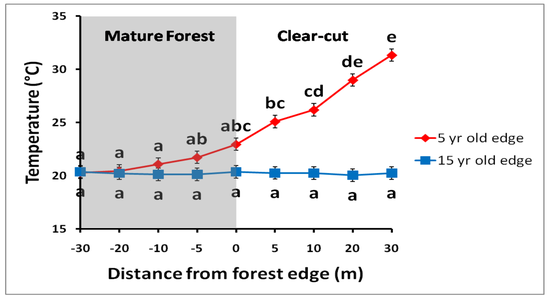

FIGURE 3. Changes in maximum daily temperature across 5 and 15 year old forest edges. Data points not sharing the same letter are significantly different (P<0.05).

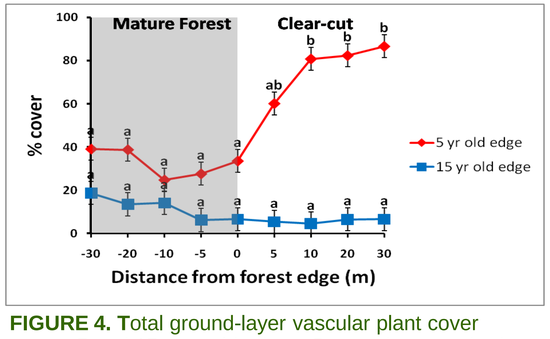

FIGURE 4. Total ground-layer vascular plant cover across 5 and 15 year old edges. Data points not sharing the same letter are significantly different (P<0.05).

❑Species richness did not show any edge gradients across the edges, but was highest in the 5 year old cuts (Figure 5)

❑Mature forest adjacent to 5 year old clear-cuts was significantly more species rich than mature forest next to 15 year old clear-cuts (data not shown)

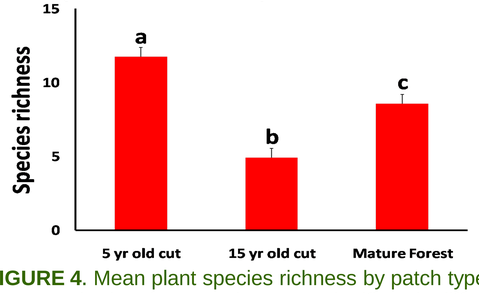

FIGURE 4. Mean plant species richness by patch type. Bars not sharing the same letter are significantly different.

FIGURE 6. Logging results in the creation of abrupt forest edges (top) which act as the interfaces between distinct ecosystems. The "edge effects" that are generated alter near-edge environments as they extend into mature forest sections (left) and adjacent clear-cuts (right).

Conclusions

❑The results suggests that the initially sharp edge-related gradients (c.f. Figure 6) in microclimate and plant cover created by clear-cutting may disappear within 15 years of edge creation in the Northern hardwood forest.

❑ This temporal change is driven by the re-growth of forest within the clear-cuts over time. As the young forest enters the stem exclusion phase, the microclimate and plant cover approach those found in mature forests, but understory plant richness may be decreased relative to mature forest.

❑ Time since harvest and the successional age of adjacent stands also appear to be important drivers of species richness.

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