Impact of partial cuts on xylophagous insect activity in the balsam fir-white birch domain: Preliminary results

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Introduction

To ensure an integrated management of natural resources, alternative silvicultural methods have been developed and their use has increased in recent years in Québec's forests. In this context, partial cutting aims at reducing the competition for soil's nutrients and increase growth within the stand by harvesting a predetermined percentage of wood (Huhta et al., 1967; McGregor et al., 1987; Smith et al., 1997). This method lowers the age of forest stands and opens up the canopy, leading to changes in the ecosystem. In addition, these treatments may impose additional stress to residual trees (Bauce, 1996), a phenomenon known as "thinning shock" (Staebler, 1956), making trees more vulnerable to xylophagous insects (e.g. Cerambycidae, Scolytinae).

Figure 1. Comparison between a natural forest (control) and a partial cut (40 %) treatment.

Figure 2. Adult scolyte observed on a peeled log.

Xylophagous insect species exploit trees that have reached a specific decaying state (e.g. stressed, moribund, recently dead), and consequently the composition of insect assemblages can provide reliable indications of the state of a forest stand (Hanks, 1999).

Objective

The objective was to evaluate the short-term effect of partial cutting on the diversity and abundance of xylophagous insects using logs cut the year following the treatment.

Experimental Site and Methods

At the Montmorency experimental forest, near Québec City (Québec, Canada), we exposed for a nine weeks period (from June 8 to August 16, 2010) freshly cut logs (2 m in length) from three different species representative of the tree flora (balsam fir, white spruce, white birch). The logs were placed side-by-side and vertically (Figure 6) in 12 experimental plots characterized by a gradient of partial cuts (0%, 25%, 40%) (Figure 3).

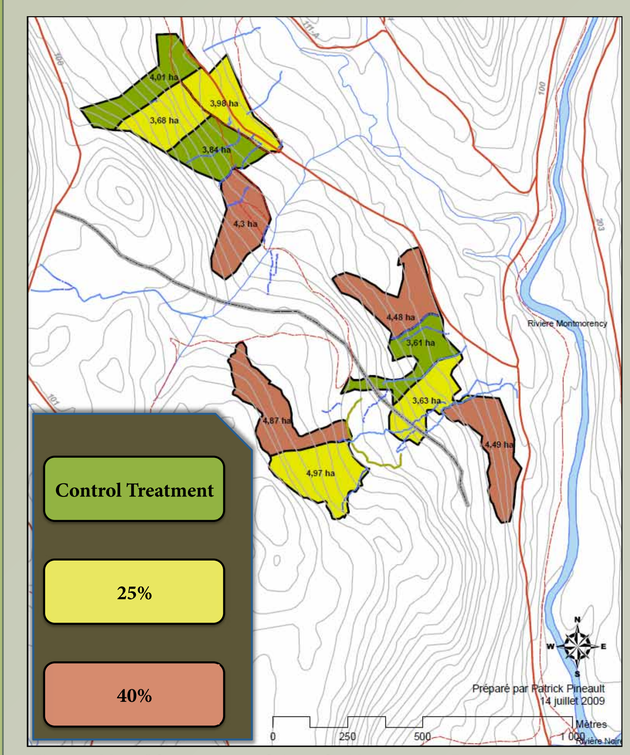

Figure 3. Map of the experimental site at the Montmorency Forest.

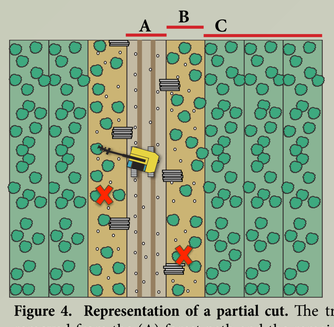

Figure 4. Representation of a partial cut. The trees are completly removed from the (A) forest path and the remaining percentage of trees to be cut is taken in the (B) selective tree felling zone. The (C) non cut zone remains intact. The red crosses represent the sites where the logs were placed in a plot.

Figure 5. Peeling of a white spruce log.

Bark peeling the logs allows us to determine the relative abundance of xylophagous insects in relation to tree species and level of thinning. Bark peeling was done on log subsamples (40 cm of the total 2 m length) to record the number of individuals living under and inside the bark (Figure 5). At this point we only considered the total number of xylophagous insects per sampling (larvae and adult stages), regardless of their taxonomic affiliation.

Experimental Design

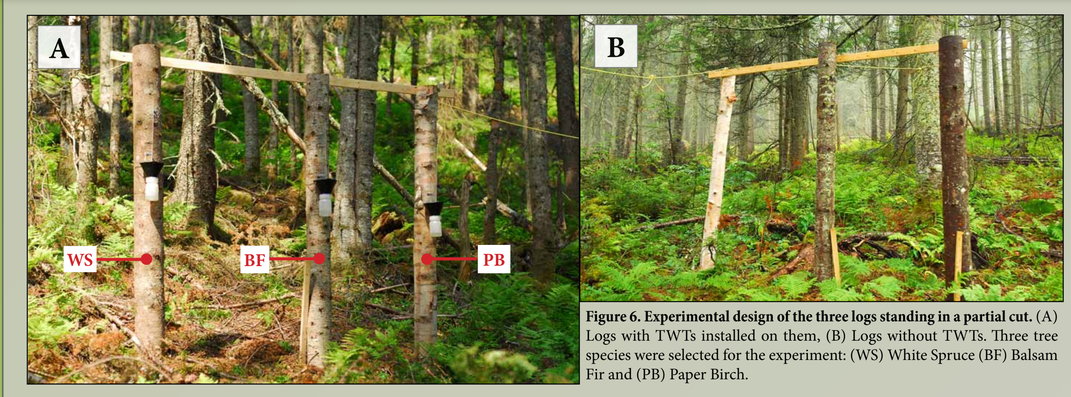

Figure 6. Experimental design of the three logs standing in a partial cut. (A) Logs with TWTs installed on them, (B) Logs without TWTs. Three tree species were selected for the experiment: (WS) White Spruce (BF) Balsam Fir and (PB) Paper Birch.

Results and Discussion

We have found very few insects in white birch logs whereas many specimens were collected from the other two tree species (balsam fir and white spruce) (Figure 7). Thus, we excluded white birch data's from the statistical analysis. The absence of response from xylophagous insects to white birch in the first three months after cutting indicates that it is not a proper substrate for colonization by these insects at the time of the study.

The preliminary results suggest that insect abundance does not differ between thinning levels (ANCOVA, P=0,1543), nor between tree species (ANCOVA, P=0.5550). However, the log's mean diameter included as a covariate in the analysis significantly influenced insect abundances (ANCOVA, P=0,0128).

We observed a very large degree of variability in insect abundance within each treatment as seen in Table 1. Such variability limits our capability to discriminate significant differences between treatments. The next step will be to identify all specimens to the species or genus levels to determine if patterns arise among specific taxonomic groups (e.g. Cerambycidae). This should allow a more accurate and detailed analysis of the xylophagous insect response after thinning in the boreal balsam fir forest.

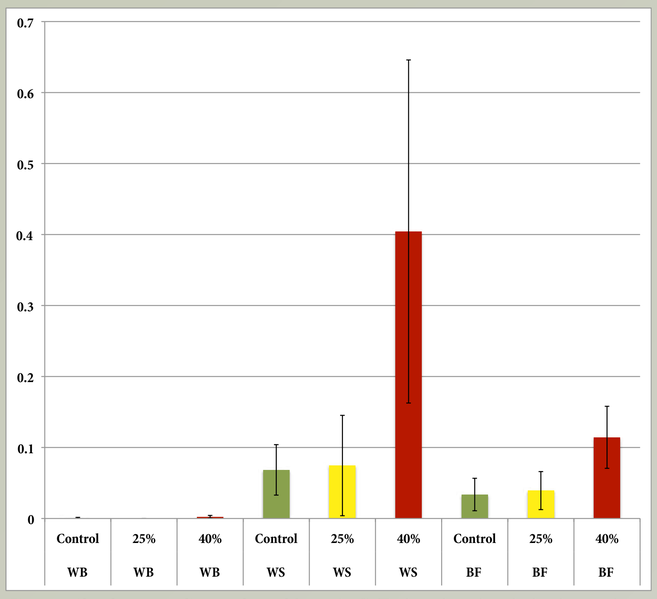

Figure 7. Abondance according to subsample's area (cm²). The bars show the calculated mean abundance (x ± se) of the three tree species in each treatment. The sampling was done on logs varying from 40 cm to 1 m in lenght.

Table 1. Abundance (x ± se) of xylophagous insects recovered from peeled logs (40 cm in length) of Balsam fir and White Spruce following exposure in partial cut forest plots. Range numbers per treatment are in parentheses.

Tree species	Control Treatment	25% Partial Cuts	40% Partial Cuts
White Spruce	121.4 ± 68.27 (1 – 307)	193.0 ± 186.01 (4 – 751)	1491 ± 943.20 (7 – 3949)
Balsam Fir	70.8 ± 47.27 (3 – 254)	79 ± 53.52 (1 – 231)	479.2 ± 226.42 (7 – 1060)

Conclusion

We cannot at this time accurately evaluate the effect of thinning on the abundance of xylophagous insects. The variability of our data is too high for statistical analyses, but sorting and identifying the specimens collected may help us detect a response to partial cutting. A better understanding of the ecological consequences following perturbations in a habitat such as a boreal forest can lead to a sound integrated management of our resources.

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