Experimental Creation of Snags on the Metolius Preserve

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Introduction

Restoration ecologists have largely sought to restore ecosystem function by first restoring the structures necessary for these processes (Bradshaw 2002). This theory rests on the idea that species richness and interaction can be restored by first recreating necessary habitat. This is sound logic; however, it is first necessary to determine how a scientist should go about creating a product of nature. This problem, like many others, can be solved via the scientific method. In recent studies, such as the one discussed here, scientists have used experimental design and the scientific method to decide which restoration methods are ideal for the creation of a target habitat.

Many native organisms, including the white headed woodpecker, rely on snags as their primary forest habitat (Stringer 2004). Snags are defined as standing dead trees, and are typically created by the interactions of beetles with dying, diseased, and dead trees alike. Bark beetles of the family Scolytidae are typically the first to attack (January 2005). These beetles burrow into trees and lay their eggs in the xylem and phloem tracks of the tree. The burrowing, along with fungi introduced by the beetle**,** interferes with the tree's natural system for water and nutrient transportation, causing the tree to inch closer and closer to death. A healthy tree can defend itself against a few bark beetles by emitting pitch to expel the beetles from its internal structure. This viscous liquid allows the tree to ward off attacks by small numbers of beetles, but the tree is ultimately overwhelmed by larger quantities.

Since the first beetles to infect a tree emit pheromones signaling other beetles to invade, large scale attacks are mounted, and a weak tree is eventually transformed into a beetle-infested snag. Later, wood boring beetles of the families Cerambycidae and Buprestidae make their home in the inner cambium of the tree, sealing its fate as an insect habitat. This natural process is followed by an interaction with even further species such as flickers, and the hairy, downy, and white headed woodpecker. Woodpeckers frequent forest snags in search of food, and peck holes in the bark to satisfy their appetite for insects. Snags therefore serve as essential and important habitat to several species across the evolutionary tree. They may seem relatively simple in structure, but they are nonetheless complex in function and rich in species interaction.

Historically, snags were maintained within the area now known as the Metolius Preserve at a density of 6 snags per acre. However, within the last century extensive logging and habitat destruction have drastically reduced this number, thereby endangering the white headed woodpecker and other dependent species. Local restorationists have designed a project to reintroduce snags via human creation. In this project, three different methods were used to create snags from previously healthy ponderosa pines. Restorationists hope they will be able to create a functional snag by first creating a snag structurally similar to those developed through natural processes. Within a few months of project initiation, groups of students monitored the progress of the respective treatments and were able to obtain initial results. Here we outline the specific treatments examined, methods for monitoring and evaluation, and preliminary results obtained from the study.

Methods

Initial Creation of Snags

Snags were originally created from healthy ponderosa pines of a mature size and adequate DBH (degree breast height). Snags were created in groups of 4, allowing for three distinct treatments and one combination of treatments. A total of forty snags describe the project, resulting in 10 experimental groups throughout the Metolius Preserve. The study was designed in this way to ensure that local environmental conditions were not a confounding variable. Snags denoted by a "T" on the attached map and data sheet stand for topped trees. These ponderosas were cut to a height of 25 feet by a logging machine, and were typically created within a small clearing. The loss of the crown immediately kills the tree by robbing it of all photosynthetic ability, thereby creating a standing dead tree. Snags denoted by a "G" correspond to trees that were girdled with a saw to disrupt the ability of the tree to transport water and nutrients via its xylem and phloem. Girdling was typically performed at approximately 4 feet above ground level, with each tree receiving two girdle bands one to three inches wide. These girdle bands encircled the entire circumference of the tree, and were created with consistent depth. Trees marked with a "B" were baited with three pheromone packets (apt inc., "Mountain Pine Beetle" Lot # 061606/1) nailed to the tree at heights of 6 feet or less. These packets were intended to mimic the pheromones produced by *Dendroctonus ponderosae* to signal to other members of its species the discovery of a new habitat. "BG" trees were both girdled and baited as described by the previous methods. All trees were labeled with a metal engraved plate to ensure their future identification.

Explanation of Monitoring Parameters

Several monitoring parameters were considered to measure the effects of the four treatments on snag development. After much deliberation, the team of students decided to note the following parameters: number of pitch tubes on the experimental tree in the three height zones, crown health, presence of sawdust, and miscellaneous notes. For the five closest neighboring trees students noted crown health (if dying or dead), distance and compass direction to neighbors showing signs of poor crown health, and pitch tube counts using the same method as for focal trees. The health of the five closest neighbors was analyzed to ensure that the creation of snags did not cause beetle infections on nearby trees. This potential problem was especially a concern in the case of snags created using pheromone packets. Neighboring tree health was initially identified using crown color as an indicator. A browning crown signified a dying tree, and a completely brown crown signified a dead tree. If a dead or dying neighbor was observed, students measured the distance and compass bearing from the sample tree to the affected tree so that the affected neighbor could be identified and monitored in future studies. Pitch tubes were counted in three areas on a tree: below 3ft, 3-6ft, and above 6ft. Pitch tubes are strong indicators of bark beetle activity, and were used in this study for assessment of the severity of the attack. Pitch tubes were either individually counted (if possible) or categorized into ranges (less than 10, 11-30, 31+) if an accurate absolute count could not be made. The students also noted presence or absence of sawdust, as it was hypothesized that this fine matter may have been produced by beetles boring into the wood. Finally, students noted observations such as presence of other insect species, woodpecker holes, and sawdust and pitch tube characteristics in the notes column. The presence of various insect and bird species may be a sign of a snag that is serving some function within the ecosystem, and has become a habitat for animals in the area.

Data Collection Methods

Students traveled in two teams of three (two students plus one instructor) and spent an average time of fifteen minutes assessing each tree. Each team assessed five experimental clusters of snags, or twenty trees total throughout the Metolius Preserve. Each group contained a designated recorder, though classifications and observations were discussed within the group before they were written down. Trees were located using the attached map of the Metolius Preserve, and are marked with a metal identification tag and blue flagging tape.

Results

In general, we observed that pheromone packets were the most effective way to structurally create snags (as measured by pitch tubes). Trees that were baited showed the highest average number of pitch tubes and one hundred percent of baited trees had ten or more pitch tubes (see graph at end of this document). Furthermore, nine out of ten baited trees had browning/dying crowns, and several trees had either woodpecker holes or other insect species present. Topping or girdling alone produced significantly lower numbers of average pitch tubes (see graph at end of this document), and seems to be a less effective way in which to create snags. Trees that were girdled and baited also produced a high average number of pitch tubes, but taking into account the results of the girdled alone and baited alone trees we can attribute these results more to the pheromone packets than the girdling.

Of all neighboring trees examined eight were affected by bark beetles and subsequently displayed pitch tubes. Of these eight, seven were in close proximity to a tree that had been baited or girdled and baited.

Discussion

Though pheromone packets do appear to create snags in the quickest and most efficient manner, we observed a potential problem with this method. Though only seven out of one hundred (5 closest trees × 20 baited trees) neighboring trees were affected with pitch tubes, a close eye should be kept on this issue. Pheromone packets may attract bark beetles not only to the experimental tree, but also to surrounding weak trees. This issue should be monitored in future studies.

Another noted result was the complete absence of pitch tubes on most of the topped and girdled trees. These results could possibly be confounding, since students hypothesized that the absence of a crown or a complete xylem/phloem system may interfere with a trees ability to make and transport pitch. It is possible that lower numbers of pitch tubes were observed on topped and girdled because the experimental treatments inhibited their ability to make pitch. However, trees that were girdled and baited were still able to produce pitch tubes, and three topped trees were observed with pitch tubes. Therefore, though this hypothesis cannot be ruled out completely, it is unlikely that the low success of girdling and topping was due to monitoring criteria chosen.

Based on our study, we conclude that baiting healthy trees with pheromone packets is the most effective way to attract beetle activity and kill trees. This treatment resulted not only in a structurally sound snag, but also a functional snag in terms of insect and woodpecker habitat. This experiment implies that restorationists can increase the density of snags within the forest, and repair this debilitated aspect of the forest ecosystem. These results are preliminary and were collected only a few months after snag treatments were conducted, however, significant results were still obtained. Future monitoring should be conducted, especially since ecosystem processes and species interactions may take longer than a few months to fully emerge. It may also be useful to collect other types of data indicative of bark beetle activity, in case the counting of pitch tubes is somehow biased toward topped trees. Ideally, sampling methods would give relative population estimates of beetles, though this may be extremely difficult data to obtain without destroying trees. Therefore, given the time frame and restraints of our study, substantial and fairly conclusive data was collected.

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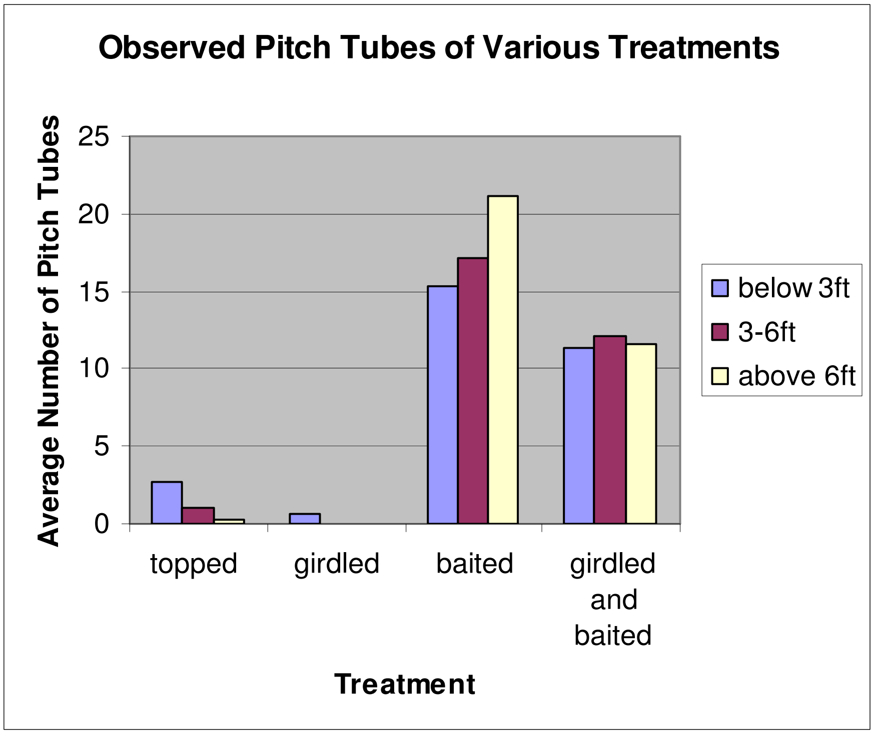
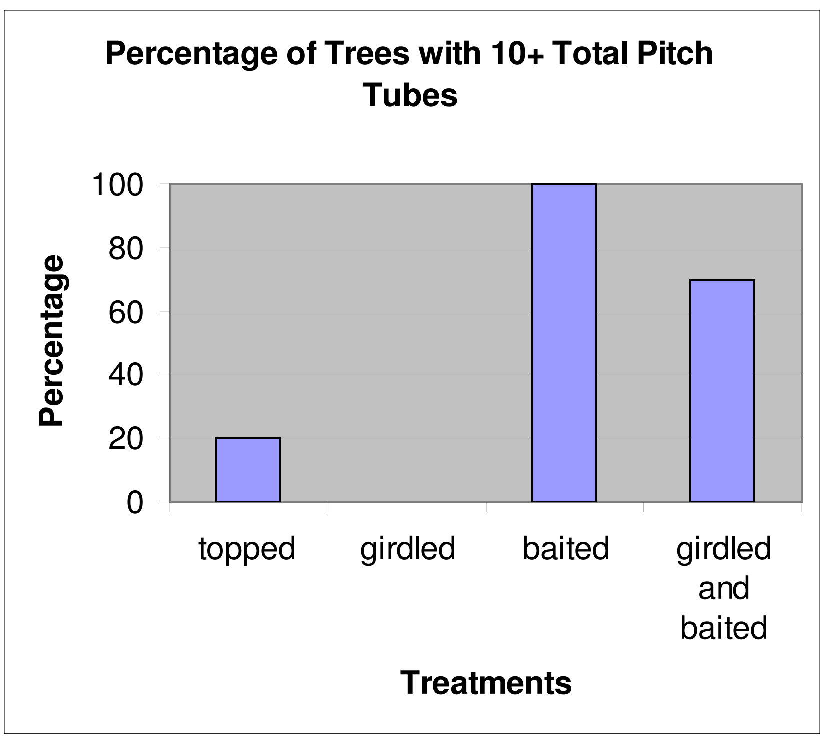

Observed Pitch Tubes of Various Treatments
Average Number of Pitch Tubes
25
20
15
10
5
0
topped
girdled
baited
girdled and baited
Treatment
below 3ft
3-6ft
above 6ft


Percentage of Trees with 10+ Total Pitch Tubes
Percentage
100
80
60
40
20
0
topped
girdled
baited
girdled and baited
Treatments