

Monitoring Snag Creation Methods in the Ponderosa Pine/ Mixed Conifer Forest Type

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Introduction

Human uses of land and aesthetic preferences have often conflicted with the integrity of natural systems in which we co-inhabit with the biotic community. In the Ponderosa Pine forest type of Central Oregon, forestry use has resulted in a heavily managed landscape; such as vaster even-age stands, lowered frequency and size of snags, increased understory vegetation, and higher fuel loads and fire ladder materials (Stinger 2004). Selective removal of dead trees for logging purposes, and to reduce crown fire potential has lead to a snag impoverished landscape (Shea et al. 2002). This combined with fire exclusion, denser tree stands, and fewer gaps has resulted in a decline of focal management species, changes in relative abundance of wildlife, and increased risk of beetle epidemic and intense fire (Stinger 2004). Standing dead trees, or snags, are important structural and functional elements to this environment. They lead to increased nutrient cycling, provide foraging and nesting sites for focal management species, and habitat for numerous other insect, amphibian and avian wildlife (Shea et al. 2002; Stinger 2005).

In this historic landscape natural disturbance regimes aided in the recruitment of these ecologically important snags. Trees stressed through interrelated naturally occurring processes such as lightning, wildfire, drought, insect infestation and disease are a critical first step to snag creation (Farris and Zack 2005). These stressed trees are more

susceptible to bark beetle infestations. Once an attack is initiated, bark beetles release aggregating pheromones on suitable hosts that lead to an overwhelming of the trees defenses and death, as well as infestation by fungi brought in by the beetles. Further decay is brought on by secondary beetles such as engravers, and wood borers of the families Cerymbycidae and Buprestidae. Foraging and fungi brought in by woodpeckers leads to more structural decay and sapwood rot, perhaps leading to sites suitable for nest excavations. This sequence and extent of these invasions is most likely critical in determining how quickly the tree dies, decays, how long it stands, and therefore its suitability to wildlife species (Farris and Zack 2005; Shea et al. 2002).

The creation of snags by artificial methods in the ponderosa pine/ mixed conifer forest is a vital component to restoring the historical structure and functional ecology of the Metolius Preserve. The current study seeks to critically analyze two methods for creation of snags by studying the beetle species diversity and abundance at topped and pheromone baited snag sites. The Metolius Preserve offers a unique experimental opportunity because it allows for the direct comparisons of several methods of snag creation in a localized area. This will hopefully help inform current and future methodologies in the creation of ecologically functional snags in the Ponderosa Pine/ mixed conifer forest type and lead to the successful return of management species such as white-headed woodpecker and pygmy nuthatch.

Methods

Snag selection and trap placement. Of the forty snags that were created one year previously (summer of 2006) on the Metolius Preserve; by pheromone baiting, topping,

girdling, and a combination of girdling and pheromone baiting, four of the pheromone baited and four of the topped snags were selected for this study. (Aggregation pheromones were for *Dendroctonus brevicomis*.) Girdled only trees still showed signs of live crowns so were excluded from the present study. PTBB type beetle traps were placed due east and at the height of about 7 and a half feet on the snag boles. The top metal loops were nailed directly into the boles. Two additional traps were placed higher in pheromone baited trees 7B and 10B at about twenty feet high and as close to east as branches would allow. This was to gauge possible altitude effects on beetle presence or absence. For high traps a weighted carabiner was used to sling parachute line over branches and once the traps were attached to the line the other end was securely tethered to a nail in the snag. To prevent excessive jostling from the wind all of the traps were secured at their bases with string tied around the tree and through the plastic holes of the trap. Consequently this lower string was of great utility in guiding the high traps safely up and down. The traps were placed in paired plots to avoid site heterogeneity effects while allowing direct comparisons within sites. Paired plot trap numbering was based on snag tree numbering: 1T & 1B, 4T & 4B, 7T & 7B high and low, and 10T & 10B high and low. All traps were filled at least halfway with 1:1 antifreeze: water mixture to allow for evaporation. Higher traps were subject to greater evaporation. The traps were kept out for seven days from June 20th to June 27th of 2007.

Beetle collection and sorting. Traps were carefully lowered and their collection receptacles removed. The antifreeze solution was drained using a strainer and beetles were placed into labeled whirl bags. Alcohol rinses of the trap receptacle and strainer were used to ensure complete yield of captured beetles. Captured woody debris such as

twigs were also rinsed for specimen samples. Beetles were sorted in Chandler Lab of the University of Oregon using dissection microscopes. Beetles of known families were labeled accordingly and morphospecies numbers were assigned to the beetles. Morphospecies were assigned by comparing size and shape of thorax, abdomen, head, antennae, and legs.

Results

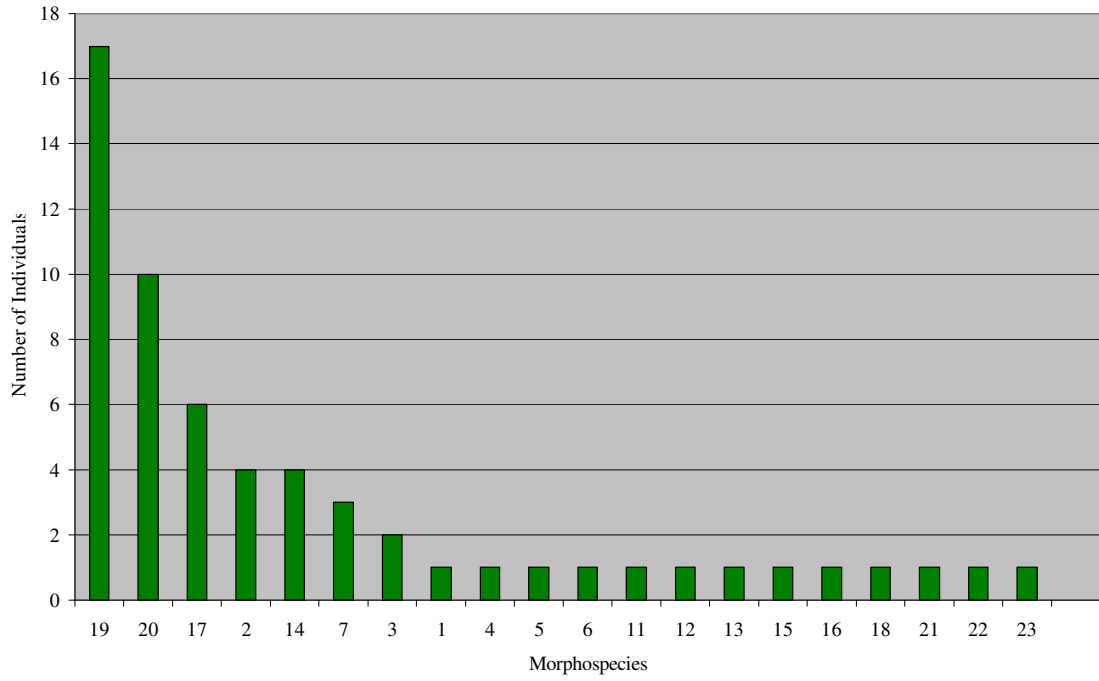
Due to the abundance and biodiversity of the beetle order Coleoptera, and the skill and time required to sort beetle genera and species, only preliminary results are available at this time. Not all morphospecies have been labeled. Qualitatively, there appears to be high diversity between traps, especially of the larger beetles, while the same smaller bark beetles species seemed to be more or less present in all four traps sorted. Preliminary results are for richness and relative abundance of morphospecies in traps 1B, 1T, 4T, and 4B. Although few replicates have been analyzed, species richness and abundance seem to be correlated within paired plots (see table 1 and following graphs).

Table 1.

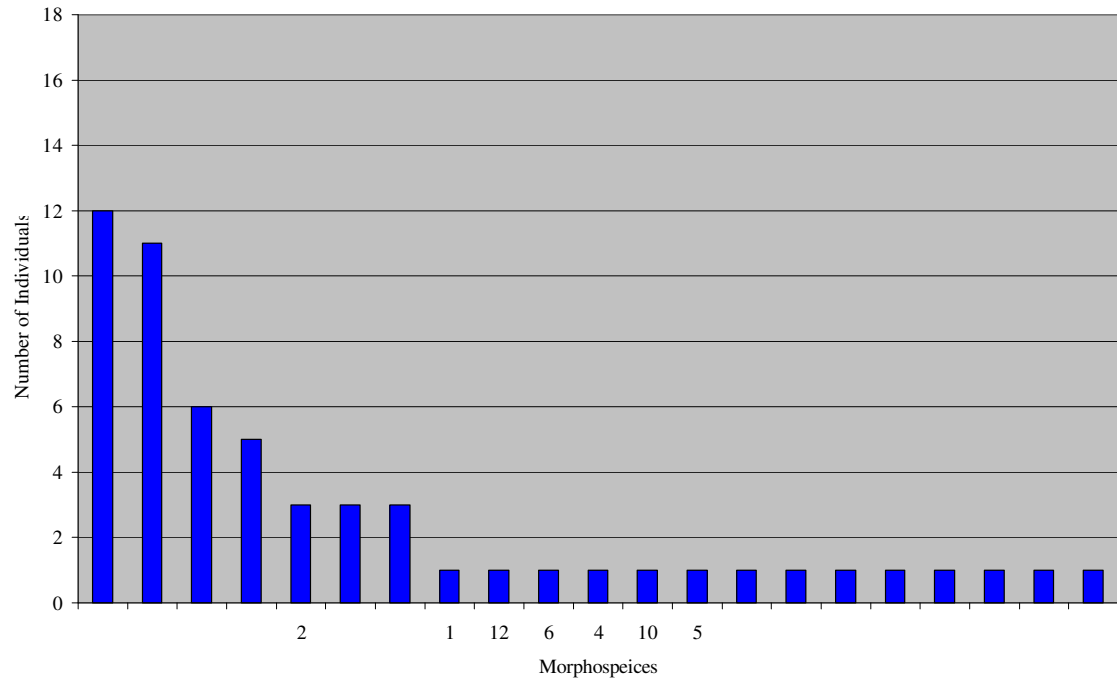
Morphospecies Richness

Snag Trial	1T	1B	4T	4B
Number of Morphospecies	20	21	14	15

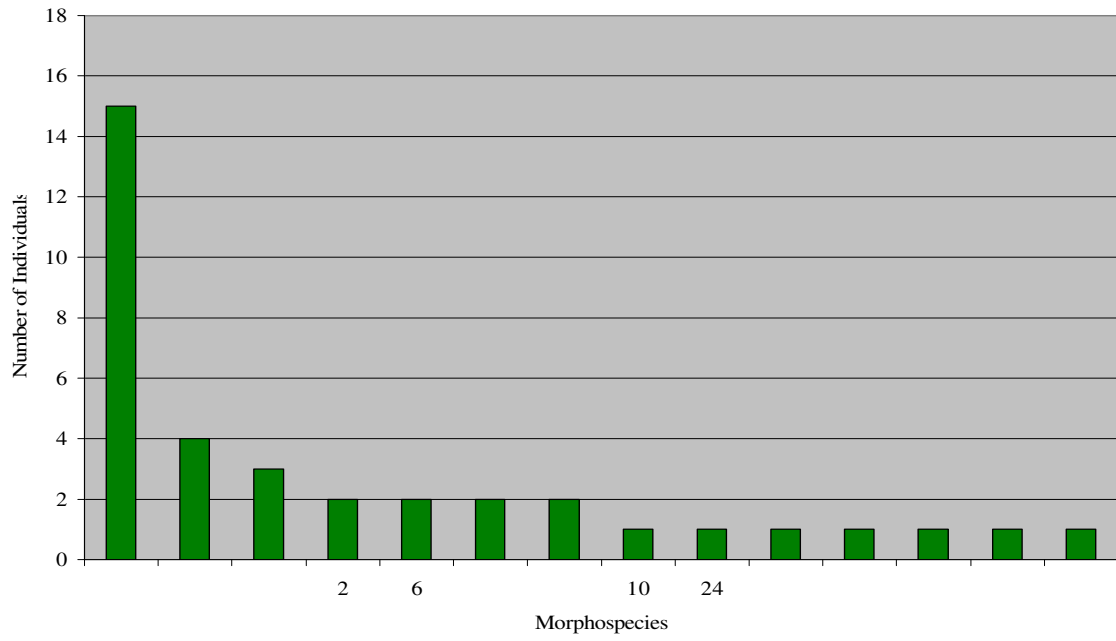
Beetles trapped at snag 1T



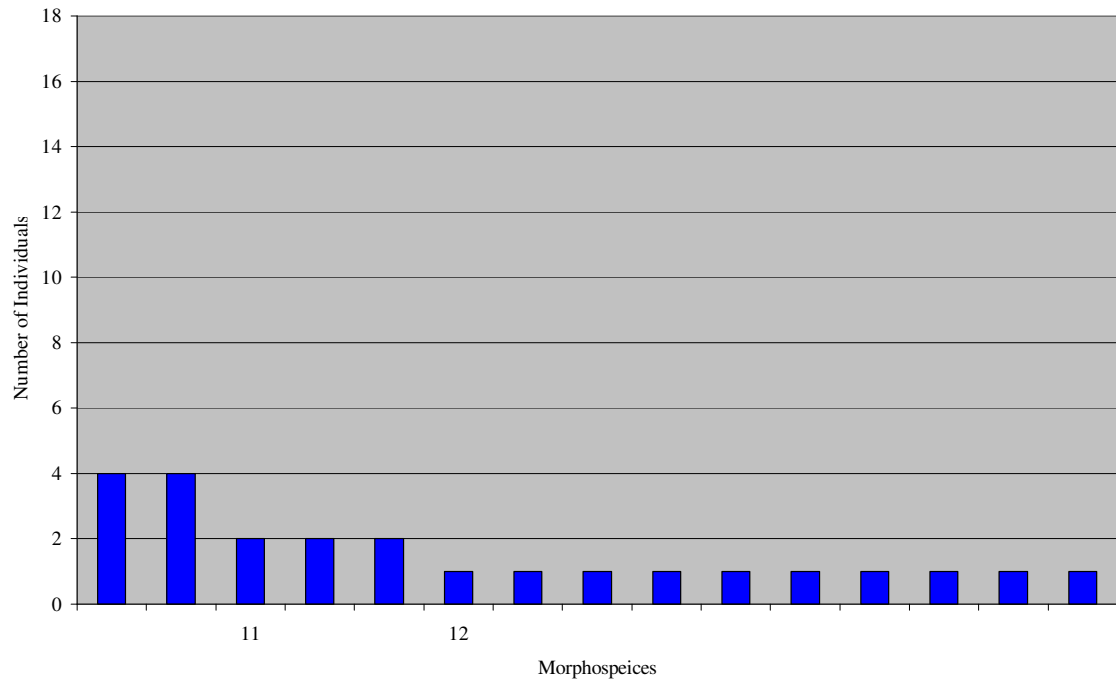
Beetles trapped at snag 1B



Beetles trapped at snag 4T



Beetles trapped at snag 4B



Discussion

The preliminary results suggest that some sites may be inherently more productive than others, as evidenced by site specific beetle species richness and abundance regardless of snag creation method. However these preliminary results require the analysis of more data points as well as further years of study to either support or reject this premature conclusion.

While there are most likely site specific factors to account for different snag decay rates, much of the literature agrees that the manner of snag creation ultimately affects it's utilization by beetle species, decay rates, structure and subsequently its suitability for foraging and cavity sites for the focal management species. As was noted in previous reports, pheromone baited snags show much higher percentage of western pine beetle infestation, secondary beetles, and foraging and nesting than other snag creation methods (Farris and Zack 2005; Shea et al. 2002). On completion of this study, and based on the previous year's observations, we would expect our results to reflect this expected higher beetle diversity and abundance at pheromone baited snags.

Central to the question of snag creation method is their utility to management species. In addition to providing prey to numerous woodpecker species, western pine beetles also facilitate infestations of red turpentine beetles and numerous other secondary beetles, thus adding to the overall decay of the snag. Secondary beetles are usually attracted to snags through the action of the kairomone ethanol, which is produced by microbial decomposition of the snag (Byers 2006). Trees that decay the fastest are generally the most suitable for foraging and also facilitate nesting. (Farris and Zack 2005) However it has also been noted that snags created by baiting are inherently more prone to

collapse due to more rapid structural decay. Although nesting woodpeckers seem to initially strongly favor pheromone baited snags, providing suitable nesting habitat as early as 5 years, girdled snags gradually gain importance as nest sites; largely due to their delayed death and onset of decay, and also tend to stand erect longer (Farris and Zack 2005; Shea 2002). Girdled trees can take up to 23 months to show outward signs of mortality, as was supported by our findings thus far, however their methodology involved removing phloem between incisions to prevent healing (Shea 2002). Although it may take many years to study, artificial girdling offers a unique area of study in snag ecology.

Host selection by *Dendroctonus brevicomis* and release of aggregating hormones (frontalin and *exo*-brevicommin) are likely to occur after landing. Frontalin is produced by males after landing and *exo*-brevicommin by females after feeding. A healthy tree is more likely to produce enough resin to “pitch-out” a boring beetle, whereas unhealthy or drought-stricken trees can’t produce the same amount of pitch resin (Byers 2006). Thus in artificially selecting host trees for pheromone treatment initial infestations may be somewhat hindered and care should be taken in selecting appropriate trees; although management concern has generally been placed more on bark beetle epidemics rather than declines, especially in highly altered and susceptible landscapes. The risk of epidemic has shown to be small given adequate care (Farris and Zack 2005; Shea et al. 2002). However selecting an already weakened or artificially girdled tree might facilitate snag infestations more readily. Girdling (by chainsaw) combined with pheromones might adequately mimic girdling from low to moderate intensity fires, which also show fast rates of decay from beetle infestations. Although this is a more costly method it may deserve more monitoring study in the future.

Although it will invariably take many years of monitoring to experimentally determine which methods prevail, cursory evaluation may suggest that a multi-pronged approach to snag creation may be suitable in restoring heterogeneous snag classes that decay at different rates. Creating snags that have varying decay rates, and therefore different decay classes at any given time, might allow the biotic community to utilize the snags more fully. For example American kestrels, bats, northern flickers, and violet-green sparrows prefer highly decayed snags, whereas white-headed woodpeckers prefer more moderately decayed snags (Stinger 2004). Baiting provides the fastest method of creating these moderately decayed snags, however use of girdled and topped snags may change dramatically as decay proceeds and nesting sites may shift somewhat to these trees and cavities more decayed snags are utilized by obligate secondary nesters, pygmy nuthatches and the species previously mentioned. There are also sex based differences in behavior in beetles to aggregation pheromones at dense aggregating sites. Having snags with a variety of beetle activity levels might more appropriately mimic the behavioral ecology of these beetle populations, principally influencing intraspecific competition and mate selection (Byers 2006).

Pheromone baited snags for Western Pine Beetles may be the most cost effective and ecologically functional snags, although the utility of other methods remains to be seen. Ultimate questions in snag ecology will be answered by which species utilize which snag types and when, how fast will snag types decay, and how long will they stand. Therefore arguably the most important phase of monitoring will be observing foraging (by flaking and drilling) and in nest site preference of focal management species.

In future snag monitoring surveys it is suggested to use metal stakes to secure traps. This will help avoid unintentionally scraping bark from the bole into the traps and allow the traps to hang parallel to the bole. Beetles collected on this bark were included in the study but their potential origin was noted.

Snags are ephemeral components of the forest and their presence and creation by natural and artificial means is vital to maintaining focal management species and restoring proper functioning of this ecosystem. One of the greatest challenges of restoration ecology is looking far into the future into a trajectory that may take many generations to achieve. Once the abiotic and biotic components are restored, it is our greatest hope that this ecosystem maintains its historical integrity.

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