Importance of Stand Structure, Tree Condition and Decay Fungi in Creating Cavities for Bat Maternal Roosting Habitat in North-Central British Columbia

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Research Objectives:

1) Determine the age of wounds, and the source of injury if possible, of trees used as maternal roost habitat, to supplement tree age and size data collected by Psyllakis and Brigham.
2) To determine the decay fungi involved in development of roost habitat; and
3) Develop recommendations for forest management practices in that promote stand attributes that support cavity nest habitat.

Summary of Methods and Findings:

An undergraduate thesis was produced from this work, which is in the process of manuscript preparation. A copy of the undergraduate thesis is attached therefore the following is only a summary of the methods and findings.

<u>Methods:</u>
Five confirmed maternal bat roost trees were non-destructively sampled, and five uninhabited potential roost trees, with similar tree and scar characteristics as the confirmed roosts, were destructively sampled.

Non-destructive sampling involved taking increment core samples at right angles to each other from O.3, 1.3, 2.3, 3.5 and 5.0m above the ground. Samples were placed in straws for transport to the lab. The decay and stain in each core was described (colour, texture) and attempts were made to isolate decay fungi onto 3% malt extract agar (MEA).

Destructive sampling involved identifying trees with similar size, decay class and scar characteristics as confirmed roost trees, but with no evidence (guano, sound as detected by a sensitive microphone) of habitation by bats. These trees were felled and bucked into 1m sections. Diameter outside bark was measured at each section, and decay and stain described and measured. Samples from each tree were removed to the lab for fungal isolation.

Both both types of sample trees, cavity volumes were estimated using increment core or wood sample measurements and mathematical formulae. Cavity wall thickness was calculated plotted on tree profile charts.

At each sample tree, stand density and volume data were collected using a 3.99m radius plot. Trees were inspected for external indicators of decay and these were recorded by species. Additional stand and tree data collected by Psyllakis was obtained and incorporated where necessary.

Results

Stand parameters for the two types of sample trees are shown in Table 1. Mean diameter at breast height for the two types of trees was not significantly different (P=0.255), and no differences were found between cavity lengths, total wall thickness and solid wall thickness (P=0.259, 0.863 and 0.113 respectively). There was a difference between cavity volume at the P=0.058 level with confirmed roost trees having larger cavities than potential roost trees.

Three of the five confirmed roost trees were shown to be infected with a heartrot fungus (*Phellinus tremulae*). A butt rot fungus (*Armillaria sinapina*) was also identified on one of the potential roost trees and is suspected in one of the confirmed roost trees. Both of these fungi occupy the heartwood and contribute significantly to breakdown of the heartwood. Other fungi identified with the help of the Canadian Forest Service Lab in Victoria were *Phialophora* cf. *fastigiata* and *Cephalosporium* sp. To date, only the former has been shown to be involved in wood decay.

Tree scars provided an entrance to the cavities, and the scars were probably caused by frost cracks. All of the scars on the destructively sampled trees were over 20 years old.

Cavity development

This study has shown that development of roosting cavities begins internally when a tree is infected with heart rot or butt rot, such as *Phellinus tremulae* or *Armillaria sinapina*. After the decay column has been initiated, the entrance is created by frost cracks, tree fall wounds or primary cavity nesters. These openings may be expanded by other wound-entry decay fungi. At this point, identification of decay fungi involved in the process is difficult as many other microflora occupy the exposed wood. It is unclear what mechanism(s) actually excavate the cavity as there was little evidence of carpenter ants or other wood borers, and the cavities were not typical of those caused by most primary cavity excavators. Some of the opening could be initiated by the physical loss of structure due to frost cracking. It is also possible that the bats were able to scratch out the decayed wood to enlarge the cavity. This behaviour has been reported from in North America (Kunz 1982).

Conclusions

Maternal bats require tree cavities in live aspen for roosting. These cavities are created through the combined process of decay (true heartrots that enter through natural openings) of the dead heartwood of living trees, and mechanical failure caused by wounding or frost cracks. A comparison of the tree and cavity characteristics between confirmed and potential roosts showed little difference, therefore destructive sampling of uninhabited trees was justified.

Aspen in older age categories are very important if maintenance of maternal bat habitat is desired. The decay fungi involved require natural openings (such as branch stubs) and to enter the tree, and much time to develop substantial decay columns. Therefore, older age classes of aspen are required.

In most regions of B.C., aspen is considered an undesirable species for regeneration. Where aspen is managed, it tends to be on short rotations to maximize productivity. Forest legislation in B.C. recognizes the importance of deciduous species for nutrient cycling, wildlife habitat and biodiversity. However, it also limits the amount of deciduous species that may be regenerated, and promotes retention of old trees in "wildlife tree patches" where no management of the species composition or age class structure occurs. Therefore, once the old aspen trees in the patches die, there are few recruits for maternal bat roosting habitat.

In order to enable the natural creation of bat habitat, aspen must be retained in harvesting operations and allowed to reach old age classes to develop decay.

NLUI Objectives

The findings from this study address at least two of the NLUI objectives as follows:

This research project determined a need for ongoing recruitment of old, decaying, but live aspen trees for maintenance of maternal bat roost habitat. It results in several recommendations that will require a change in policy and forest practice at least at the local (Ft. St. James District) level. Although the project was focused on bat habitat, our findings may apply to other cavity nesting organisms. Results from the study will be made available to the Ministry of Forests and the Ministry of Environment, Lands and Parks.

The project also will assist with long-term land use planning that is aimed at environmental sustainability. Current forest management policy recognizes the need for wildlife tree patches, and other methods that preserve habitat diversity, and therefore species diversity. However, retention patches are identified in the cut-block planning stage and are often placed in areas where there is low commercial timber value, and a high frequency of dead trees. The patches are either left unmanaged, or are slated for harvest once the surrounding cut block has reached a specified stage of development. This study has demonstrated that old but live aspen, with extensive decay columns, need to be maintained in enough density to provide suitable habitat for maternal roosts. This can only be accomplished through long-term planning that spans several rotations. Should aspen become a more desirable commercial species, then this long-term planning for cavity nest habitat becomes even more critical.

During the research project we used local labour (a faller and a survey assistant), consulted with the research team headed by Jen Psyllakis (who also used local research assistants), and the manager of the John Prince Research Forest.

A manuscript of the research is in preparation and we plan to submit it to a refereed journal. Copies of the published paper will be made available to Prince George Region Ministry of Forests, Ministry of Environment, and the John Prince Research Forest.

Table 1. Comparison of stand parameters for confirmed and unconfirmed roosts.

Roost Tree Type	Total Density (sph)	Stand Vol. (m^3/ha)	Aspen			
			Stand Density/ha	Stand Vol. (m^3/ha)	% of sph	% of Vol.
Confirmed Range	600-2000	3600-5400	400-800	300-700	20-100	6.3-13.9
Confirmed Mean	1000	4200	520	460	63	11.1
Potential Range	1000-2000	3600-6600	400-1600	1800-4800	40-100	44-100
Potential Mean	1520	5280	960	3600	65	67