RESEARCH SUMMARY

forest sciences
NELSON FOREST REGION

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Bats and Trees

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- **Bats prefer large trees that are uncluttered by surrounding vegetation**
- **Bats prefer Western White Pine trees for roosting**

INTRODUCTION

In summer, temperate zone bats spend over half of each day in a roost site. The choices made by bats with respect to the type and location of roost sites have a strong influence on their survival and reproductive success. Roosts provide protection from predators, and serve as sites for social interactions and the rearing of young. They also provide bats with a stable thermal environment and protection from the elements. By clustering together in a roost, individuals can reduce the loss of heat

Bats roost in a variety of structures, including caves, man-made structures, rock crevices, and trees. Although the habits of bats roosting in caves, man-made structures and rock crevices are relatively well known, few studies have specifically investigated the roost-site characteristics of forest-dwelling bats.

Many bat species reside in forests and are considered to be dependent on trees for their roosting sites. Therefore, understanding roost-site requirements is essential for proper management of forest-dwelling bat populations. Bats have traditionally not been considered in forest management plans, and little attention has been paid to maintaining adequate roosting habitat. Recently, biodiversity and ecosystem management initiatives have led to the inclusion of bat habitat requirements in the planning process. However, these efforts have been frustrated by the lack of information about roosting and foraging habitat preferences.

To address these information needs, a two year study on the roosting habitat requirements of forest-dwelling bats was initiated in the West Arm Demonstration Forest (WADF), Kootenay Lake Forest District in 1993 (2). The objectives of this study were to locate and characterize tree roosts used by bats, and to determine whether bats were selecting trees with particular characteristics.

Figure 1. Typical roost tree.

STUDY AREA

The study was conducted in the Kokanee Creek and Redfish Creek watersheds in the WADF from May-August in 1993 and 1994. The study concentrated on bats in the ICHdw and ICHmw2 biogeoclimatic subzones, which are found at low and medium elevations, respectively

METHODS

Bats were captured in mistnets set over slow-moving or still water, along forest opening edges, and across roads at various locations and elevations. Species, sex, age and reproductive condition was assessed.

Roost sites were located using two methods. The first involved watching trees at dusk for emerging bats. Trees with good roost site potential were selected at various locations within the study area, and observed from 10 minutes before to 30 minutes after local sunset. The second method was radio-tracking. Very small radio-transmitters were attached to females and males of three bat species (Silver-Haired bats, Lasionycteris noctivagans; Western Long-Eared bats, Myotis evotis; and Long-Legged bats, M. volans), and to female Big Brown bats (Eptesicus fuscus).

Radio-tagged bats were located during the day using receivers, and all roosts identified by radio-tracking were verified by watching the tree at dusk for emerging bats. This also provided data on colony sizes, entrance heights, entrance aspects, and residence times in a particular roost site. Residence times are conservative estimates as it is not known how long colonies or individuals used roost trees before they were observed in this study The horizontal distance between subsequent roost trees used by the same individual was also measured.

A 0.1 hectare circular plot was identified around each roost tree, and the species and decay stage of the roost tree were recorded [based on the nine decay stages identified in the British Columbia Wildlife Tree Classification System (1)]. A variety of site and tree characteristics were also measured (Table 1).

To determine whether bats selected trees with certain characteristics, a sample of other available trees (non-roost trees) was measured for comparison with roost trees. Only trees in decay stages 2-7 were measured (i.e. defective live trees or standing dead trees), as other decay stages don't provide suitable roosting opportunities for bats.

Table 1. Tree and site characteristics measured.

Tree Characteristics	
DBH	% Bark Remaining
Tree height	# Limbs
Tree height relative to canopy height	
Site Characteristics	
Slope	
Elevation	
Elevation above valley	
% canopy closure	
Canopy height	
Number of canopy layers	
Distance to nearest edge	
Distance to nearest water	
Available tree density	
Distance to nearest tree	
Height of nearest tree	
Distance to nearest tree of ≥ height	
Height of nearest tree of ≥ height	
Distance to downslope tree	
Height of downslope tree	
Height of downslope tree relative to roost tree	
Distance to nearest available tree	

RESULTS

Twenty-one roost trees were located over the two summers. Sixteen trees were found by radio-telemetry and five by surveillance. Fourteen of the roosts were beneath loose bark, five were in abandoned woodpecker hollows, and two were in other naturally formed cavities. Eight roost trees were used by Silver-Haired bats, five by Long-Legged bats, three by Western Long-Eared bats, three by Myotis spp., and two by Big Brown bats. Groups were generally small (about four individuals), and bats were commonly found roosting alone.

Statistical analysis of tree and site characteristics showed that only three variables significantly discriminated between roost trees and other available trees. Tree height was the strongest discriminator followed by horizontal distance to the nearest available tree and percent canopy closure. Roost trees tend to be taller, closer to other available trees, and have lower percent canopy closure than random available trees (Table 2). These results suggest that roost trees are easily distinguishable from available trees.

Table 2. Variables which Significantly Discriminate Between Roost and Available Trees.

Variable Mean (SD)	**Roost Trees Mean (SD)**	**Avail. Trees**
Tree Ht. (m)	27.5 (7.76)	9.8 (8.38)
Dist. Nearest Avail. Tree (m)	3.8 (2.11)	7.5 (8.70)
Canopy Closure (%)	35 (24.7)	52 (23.2)

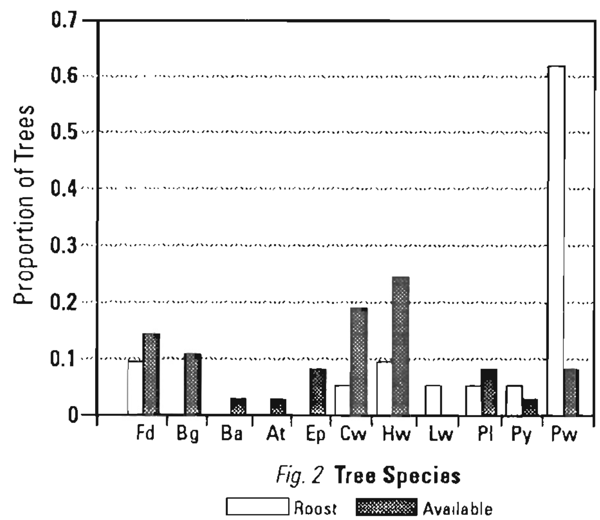

Figure 2. Roost trees by species.

Bats preferred western white pine, and to a lesser extent western larch and ponderosa pine. Bats roosted less frequently than expected in Douglas-fir, lodgepole pine, western hemlock, and western red cedar. No bats roosted in grand fir, subalpine fir, or trembling aspen (though other studies have found bats roosting in aspen) (4). Twelve of the 14 bark roosts were located in western white pine trees, and the other two were in a lodgepole pine and a western hemlock. Cavity roosts were located in western hemlock, Douglas-fir, western white pine, western red cedar, western larch, and ponderosa pine.

Bats also did not roost at random with respect to the availability of different decay stages (Fig. 3). Bats only roosted in trees of decay stages 2, 4, and 5, and roosted more frequently than expected in decay stages 4 and 5. All bark roosts were found on trees in decay stages 4 or 5 (seven in each). Cavity roosts were located in all three decay stages (one in stage 2, two in stage 4, and four in stage 5).

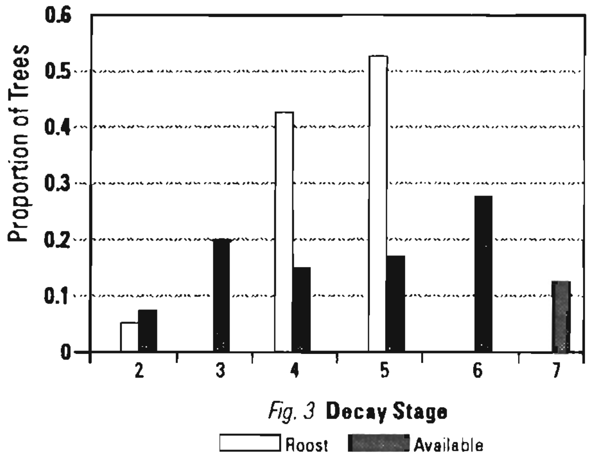

Figure 3. Roost trees by decay class.

The mean roost residence time for individual bats was 11 days. With maternity colonies excluded, the mean residence time was 6 days. In only one case was an individual bat observed using the same roost tree on different occasions. The horizontal distance between subsequent roost trees used by the same bat varied over a relatively small range (28-206m, mean 119m). Roost switching distance did not differ significantly between the different bat species, but did differ between individuals.

DISCUSSION

Bats in this study preferred tall trees close to other available trees, surrounded by a relatively open canopy. Similarly, other studies on tree-roosting bats have found that bats prefer either large diameter or tall trees, and trees that are relatively uncluttered by surrounding vegetation (4). Thus, across different forest types the pattern is the same: bats prefer large trees with relatively low amounts of clutter. There are several possible explanations as to why bats prefer large, uncluttered trees, including increased protection from terrestrial predators, increased exposure to sunlight, greater ease of access to and from the roost, and the opportunity to use the tree as a landmark, making it easier to find compared to trees concealed by the canopy.

Bats preferred trees of particular species and particular stages of decay. We expect that the tree species preferences of bats should differ between bark and cavity roosting bats, but in both cases be related to differences in decay characteristics between tree species. With only two exceptions, all bark roosts were on western white pine trees of decay stages 4 and 5. During the decay process, this species characteristically develops sheets of bark which loosen progressively, thereby providing suitable hollows between the bark and sapwood. The observed preference by bats for western white pine suggests that they may simply be selecting trees which provide them with suitable roosts, rather than a specific tree species, per se.

The tree species and decay stage preferences of cavity roosting bats are closely tied to the dynamics of natural cavity formation and the preferences of primary cavity-excavating birds. In the WADF and other areas of the Nelson Forest Region, primary cavity-excavators exhibit strong preferences for western larch and trembling aspen (3). Furthermore, these birds prefer trees with decayed heartwood but relatively hard sapwood, as trees in this condition are relatively easy to excavate, but still provide insulation and protection from the elements and predators. Natural cavities with similar characteristics may form, provided that a path for infection is created through limb detachment, lightning strike, frost cracks or other trunk wounds, or top-breakage.

The study showed that bats frequently moved between roost sites, switching roosts on average every 11 days, or every six days for non-maternity colonies. Furthermore, subsequent roosts tended to be nearby. These results suggest that bats exhibit fidelity towards a particular area or group of trees rather than to any one particular tree. Bats may switch roosts in response to disturbance, to avoid predators, to interrupt parasite life cycles, to minimize commuting distance if bats change their foraging areas, or to take advantage of differing microclimate and structural conditions within different roost sites. However, the potential benefits of roost-switching must trade-off with the costs associated with switching to new roost sites. These include the time and energy to locate a suitable roost, increased exposure to predation while searching, and potential disruption of the social structure of a colony. Having several roost sites within a small area may minimize these costs as search and travel times will be relatively low, and individuals need not explore unfamiliar areas.

MANAGEMENT IMPLICATIONS

Current forest-harvesting practices may not provide enough suitable habitat for tree-roosting bats to maintain populations at current levels. Relatively large clearcuts remove large proportions of the available roosting habitat. The remaining forested areas are often deficient in suitable roosting habitat because older stands are the ones most often targeted in forest-harvesting operations.

Older stands provide snags with larger than average heights and diameters across a wider range of decay stages, and are typified by greater tree spacing and large gaps in the canopy. Thus they provide more suitable roosting habitat for tree-roosting bats than do younger stands. Second growth stands in which a significant component of large trees are retained may also provide suitable roosting habitat. However, if forest stands are intensively managed or are on a relatively short rotation cycle, the availability of large, older trees that are suitable for roosting will decrease.

It is not known at this point whether requirements in the Forest Practices Code for leaving wildlife tree (WLT) patches will provide suitable habitat for tree-roosting bats. Depending on WLT patch design, retained trees in cutblocks may provide the range or number of alternative trees necessary to meet the needs of bats, given their movement patterns and roost tree preferences. However, it is important that patches are large enough to be "thermally buffered", and that they contain a selection of suitable roost trees (of preferred species, size, decay characteristics, bark characteristics, etc.) to ensure protection from predators and the elements. It may be that the requirement of bats for suitable alternative roost trees will only be met by maintaining relatively large reserve patches or areas of intact forest.

Forest management should take into account the preference of bark-roosting bat species, for western white pine. Western white pine is relatively rare and only locally abundant in the forests of southern B. C. Populations of western white pine have been severely reduced by white pine blister rust and by a century of timber harvesting. Thus, the availability of trees which can provide suitable bark roosts may be low, and bat species which are restricted to roosting beneath loose bark may be roost-site limited.

Special attention needs to be focused on providing suitable roosting habitat for tree-roosting bats, as this group of animals has traditionally not been considered in forest management practices.

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