Bear den site selection and considerations for forest management in the interior of British Columbia

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INTRODUCTION

Carnivore lethargy, winter sleep, and hibernation are all terms that are used interchangeably to refer to the winter habits of bears. However, bears are not true hibernators but rather enter a phase of lethargic winter sleep. This stage of the bear life cycle can be best described as a period of dormancy during the winter months where the animal ceases drinking, eating and voiding wastes (Hellgren 1998). During this time the body temperature of bears stay at or near normal body temperature unlike true hibernators such as some rodents whose body temperature drops to ambient temperature (Folk et al 1976). Hayes and Pelton, 1994, suggested that the purpose for the evolution of this behaviour in the life history of bears is to minimize stress caused by a paucity of food during the inclement weather of the winter months. During this period, the heart rate and metabolic rate drop to 25 % and 68 % of normal levels respectively (Folk et al 1976, Hellgren 1998, Watts 1990).

As a result of this complex life history strategy, denning bears are susceptible to disturbance resulting in physiological stress within 1000 m of the den site, these effects are particularly acute when disturbance occurs less than 200m from the den (Linnell et al. 2000). Therefore it is important that we understand where bears den and the associated ecological and management concerns that are associated with these vital habitat features. Very little research has been done in the interior of British Columbia that looks at bear dens as wildlife habitat features and provides practical field solutions to mitigating impacts from industrial forestry.

In this project, we focused on black bear dens in central British Columbia. Over the past four years we have conducted field research looking at black bear den site

selection, specifically we looked at; the geographical and ecological variables associated with the den areas; and, the forest management implications of implementing mitigation strategies to reduce the disturbance to bear den sites. Our research considered three different types of dens; natural rock cavity dens, excavated soil dens, and tree cavity dens. The research was conducted in two separate phases and will be presented separately in this report with management recommendations/implications drawing on both data sets.

STUDY AREA

Our study areas are concentrated near the John Prince Research Forest (JPRF), Tanizul Timber's Tree Farm Licence (TFL 42), the Alex Fraser Research Forest (AFRF), and the Aleza Lake Research Forest (ALRF). The JPRF and TFL 42 are both located in the Fort St. James Forest District in the Sub-Boreal Spruce Biogeoclimatic (BEC) Zone. The AFRF is located in the William's Lake Forest District in two separate locations, one in the Interior Douglas Fir BEC zone and the other in the Sub-Boreal Spruce BEC zone. The ALRF is located in the Prince George Forest District and is also in the Sub-Boreal Spruce zone.

METHODS – PHASE 1

Phase 1 included the assessment of 25 dens and associated timber values in the surrounding stands. Dens were located using reconnaissance surveys, traditional aboriginal knowledge, spring back-tracking, and forest worker reports. We collected the following information: den type (excavated, tree, rock cavities), GPS location, elevation, aspect, tree age class, tree crown closure, tree height class, and leading

timber type (dominant tree species). Gross timber volume (cubic meters/ha) was estimated from forest inventory maps. This technique is based on timber values obtained from aerial photo interpretation and is commonly used by forest practitioners in BC. We tested the accuracy of our volume estimation method by completing 17 industry standard timber cruise plots at random den sites (Cruising Manual, BC Ministry of Forests 2001).

We used analysis of variance (ANOVA; Sokal and Rolf 1995) to test the differences in the den site aspect, elevation, leading timber type, and timber volumes among den types. Normality was tested using a Kolmogorov-Smirnov test (Zar 1984). Homogeneity of variances was tested using a Levene's test (Milliken and Johnson 1984).

RESULTS – PHASE 1

In phase 1 of the project, we found that excavated dens were located in all timber types with the highest proportion occurring in Lodgepole pine leading stands. The single tree den used in this analysis was located in a Douglas Fir leading stand. The rock cavity dens were located in Sub-alpine Fir, Hybrid Spruce, and Douglas Fir leading stands, with the majority of the dens occurring in Douglas Fir stands. (Figure 1). Timber volume around bear dens varied by den type, $F(1,1)=8.57$, $p=0.008$, with excavated dens occurring in areas of higher timber volume relative to our tree and cavity dens (Figure 2).

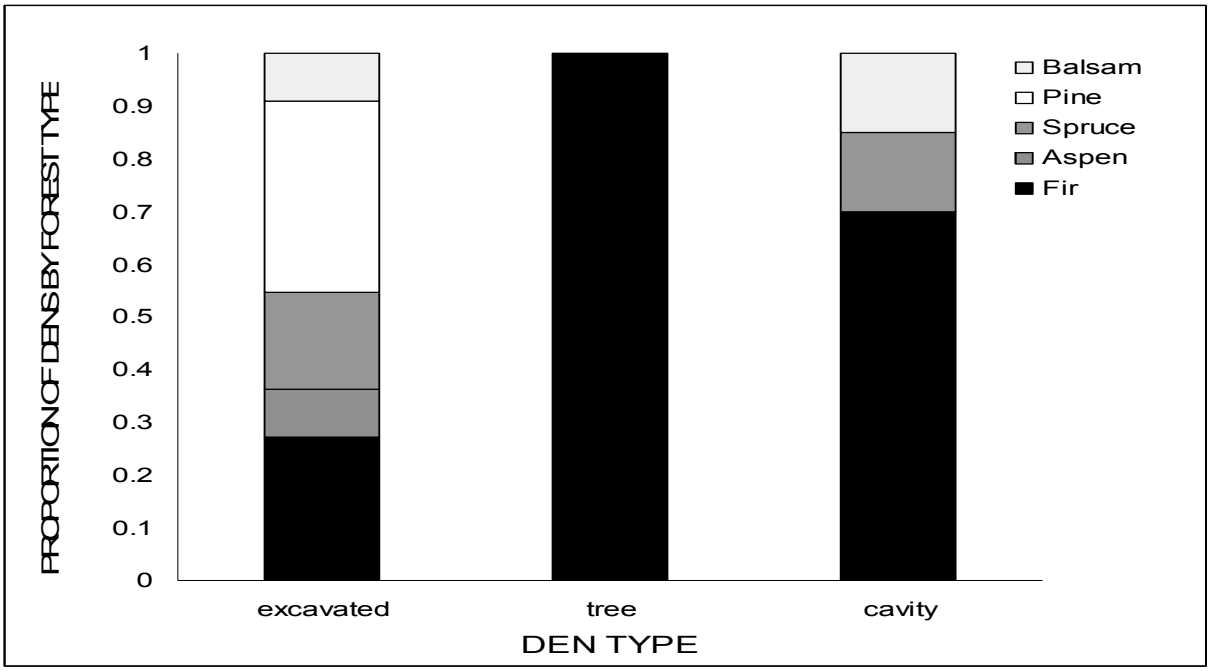

Figure 1. Differences in forest types that the three den types were located in. Note: Fir refers to Douglas Fir.

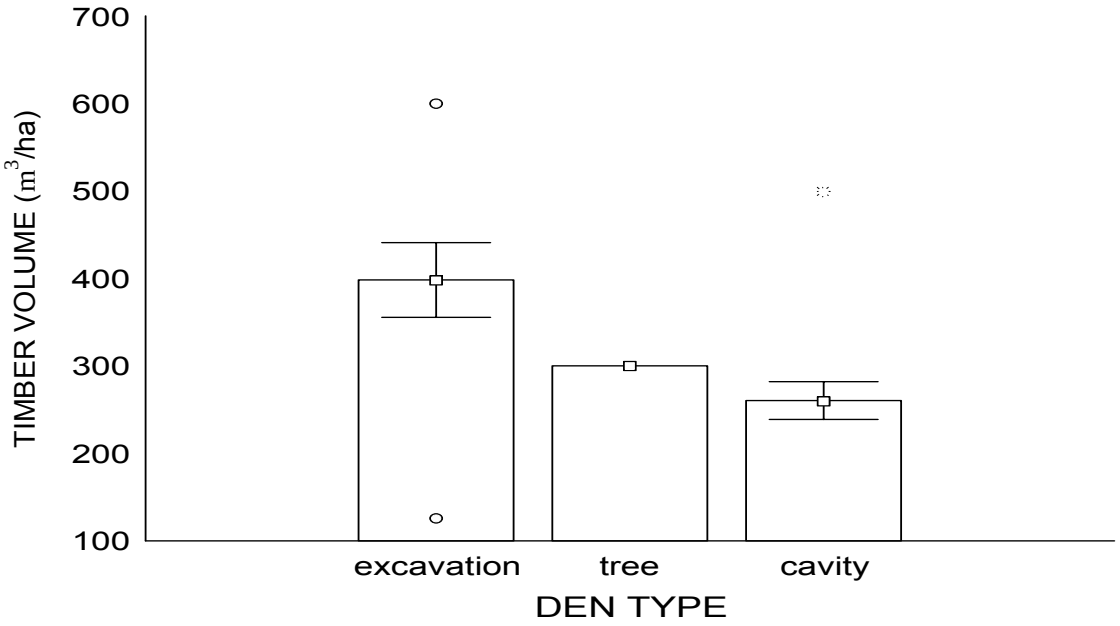

Figure 2. Differences in timber volume around the three den types. Note: We include our single tree den here for purposes of comparison; °indicates outliers; * indicates an extreme outlier. Our volume estimations using aerial photography underestimated our timber cruise calculations by 4.1%.

The three den types were located at significantly different elevations within our study area, $F(1,1)=6.21$, $p=0.021$. On average, excavated, tree, and rock cavity dens were located at 853, 842, and 983 m asl, respectively. Since we only had one tree den at this point the analysis for that den type could be misleading. We detected no difference, $F(1,1)=0.93$, $p=0.346$, in aspect upon which the den was located between our den types.

DISCUSSION – PHASE 1

Our findings indicate that excavated dens can be located anywhere on the landscape given suitable soil conditions, making it very difficult to predict their location. Rock cavity dens were often located in concentrations and easier to locate since they are associated with rocky outcrops and ridges. Excavated dens were normally located on flatter terrain, providing easier access for operational forestry activities. Rock cavity dens were located at higher elevations in more difficult terrain making forestry operations less practical. We determined that there were significantly higher timber volumes in areas surrounding excavated dens compared to rock cavity dens. Since lower timber volumes equate to reduced logging revenues, there is a reduced cost associated with leaving buffer zones around rock cavity dens relative to excavated dens. Furthermore, rock cavity dens are associated with more difficult terrain that translates into higher logging costs and lower profit margins (pers. comm. P Valk; Forest Operations Manager (retired), BC Forest Service). Schwartz et al. (1986) reported that the more permanent rock cavity dens were most important to bears in Alaska and had been reused up to 75 % of the time over the life of their project.

We suggest that the recommendation of establishing a 200m or 1000m buffer proposed by Linnell et al. (2000) will have different economic impacts on forest management activities depending on which type of dens are prominent in the operating area. As a result, management priority should address the more permanent, and most often reused, rock cavity dens.

METHODS – PHASE 2

We examined 41 dens during the summers of 2004 & 2005 and completed a detailed ecological assessment of the area around each den. Of these, there were 12 excavated, 10 tree, and 19 rock cavity dens. Dens were located using reconnaissance surveys, traditional aboriginal knowledge and spring back-tracking and were identified as bear dens by nest and bedding materials, presence of hair, etc. At each den location, we recorded detailed site, soil and vegetation information. Tree dens were accessed using single rope and spur climbing techniques. Some tree dens were classified as dens without climbing up to the den as a result of there being no safe access point because of extensive decay in the tree. We used a combination of factors such as intensive claw marks, bedding materials, presence of a large cavity, hollow stem, etc to make these classifications.

RESULTS – PHASE 2

Excavated dens were located almost exclusively in areas of deep, fine textured soils that were composed mainly of sandy and loamy materials with a minor clay component. Tree dens were mainly located in sandy soils (alluvial floodplains) with the exception of a Douglas Fir tree den that was located in more coarse textured and rocky

soils. Rock cavity dens were located exclusively in rocky outcrops consisting of both exposed bedrock and boulder piles.

The data indicates that, with the exception of tree dens, bears predominantly choose mid to upper slopes as denning sites. The tree dens are located in the valley bottom where ecological conditions encourage the growth of large diameter trees. These valley bottoms are also prone to flood events that make ground dens less suitable.

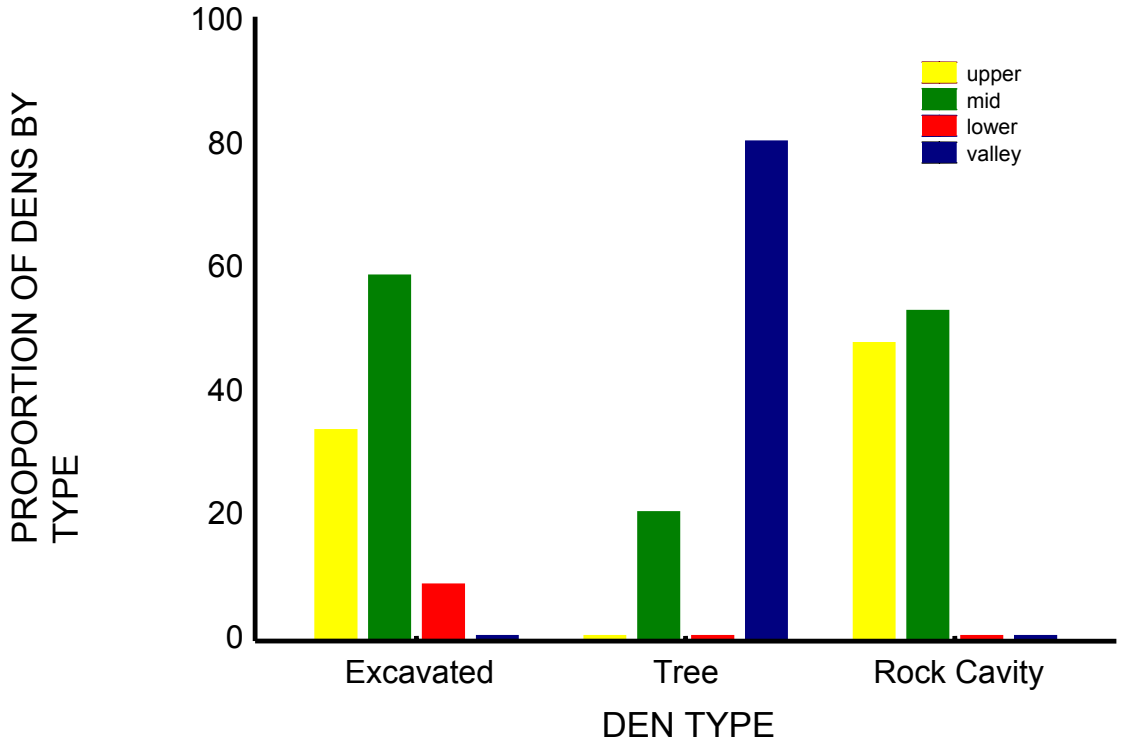

Figure 1: Proportion of dens located at different slope positions.

We detected no difference between den type and aspect in our study area. All den types were found on various slope aspects. We determined that there was a strong link to site series ecological information and type of bear den found in that area. We

found that excavated dens were most often located in mesic sites with tree and rock cavity dens located in hygric and xeric sites respectively.

DEN TYPE	SITE SERIES					
	01	**02**	**04**	**07**	**08**	**14**
Excavated	10		1		1	
Tree			1	1		8
Rock Cavity	2	15	2			

Table 1: Number of dens located in various site series units.

NOTE: Site Series Descriptions

Site Series Unit ecological classification is a site specific ecological description under the British Columbia Biogeoclimatic Ecological Classification system. Ecological site information consists of collecting accurate site, soil, and vegetation information and then using the various indicators to identify the site series unit that best fits the situation. Each site series is given a two-digit numeric code that relates to its position on the relative moisture and nutrient scales. The site series units in forested areas are numbered as follows: the 01 site series is the zonal or mesic site, with the remainder ranked from driest (02) to wettest (generally 09-12). In our study area we have an additional site series (14) that describes the alluvial floodplain ecosystem (Delong 2003; Delong et al. 1993; Steen and Coupe 1997).

DISCUSSION - PHASE 2

Our findings indicate that it may be possible to determine areas that are suitable for different types of bear dens according to site series unit ecological data. This information is the most widely used ecological classification system by both industry and government in British Columbia and therefore it is very accessible and practical to use. Excavated dens typically occur on mid to upper slopes and in deep, well drained

soils. Forestry field staff should note these areas and conduct field reconnaissance as part of site planning, especially if the site prescription calls for winter logging (which is normally the case in these parts of our study area because of soil compaction issues). Rock cavity dens are also located at mid to upper slope positions but on very dry, rocky sites. These areas are generally not highly productive forest zones and should be considered as wildlife management or retention reserves (Linnell et al. 2000). If logging is to occur near these sites it is advisable to do so in summer logging operations as to not impact sleeping bears (due to coarse soils these sites normally are suited for summer harvest). In our study area, tree dens are located mainly in valley bottom floodplain zones, with sporadic sites on mid slope positions. Floodplain zones are located near significant stream or rivers and should be considered as part of the riparian management reserve zone. Den trees in other areas should be retained as a wildlife habitat features.

We suggest that using this information as a guide can help forest managers mitigate the risk of disturbing bears during the winter sleep period and preserve important winter habitat for bears in the central interior of British Columbia.

MANAGEMENT RECOMMENDATIONS / IMPLICATIONS

Our research suggests that different types of dens have different ecological characteristics and therefore require different approaches to management. The more permanent natural rock cavity and tree dens have higher potential value than excavated dens. However, areas with ideal soil conditions and high densities of excavations should also be given special attention by forest managers.

In the areas of the John Prince Research Forest and Tanizul Timber TFL 42, special attention should be given to rocky ridges that have high densities of natural rock cavities. These areas should be incorporated into reserve areas with minimal winter disturbance in a 200m buffer zone as suggested by Linnell et al, 2000. These areas typically have less economic timber value and higher ecological significance for bears.

In the Aleza Lake Research Forest, special attention needs to be given to the cottonwood forests along the Bowron River. This area should be considered as a permanent reserve and a special ecosystem zone. In addition, as a result of the wetter environment at the ALRF, the well drained soils along gullies such as Camp Creek, and other areas of Site Series 01 or 06 should be given special consideration.

Generally, bears chose excavated dens in forest ecosystems that were in Site Series 01. When planning management activities in these areas, managers should pay particular attention to sites along the mid to upper slope. Tree dens were typically found in riparian areas where rich moisture and nutrient regimes produce large cottonwood trees, in the case of the ALRF this was in a special Site Series 14. Rock cavity dens were almost exclusively found in the dry units characterized by Site Series 02-04. These are typically poor sites in terms of moisture and nutrients. Any rocky outcrops or boulder piles in these areas should be considered priority management zones.

We will continue to monitor the dens in our study areas to determine reuse and rates of disturbance. In particular, we will identify and investigate more tree dens along the Bowron River at Aleza Lake Research Forest to attempt to better understand the denning behavior of bears in this locally unique ecosystem.

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