Mountain Beaver Abundance in Young and Mature Forest Stands

Submitted To:

Doug Ransome PhD.
Fish, Wildlife and Recreation Program
British Columbia Institute of Technology
Burnaby, BC

And

Doug Wilson
Manager, Parks Department
Fraser Valley Regional District
Chilliwack, BC

Submitted By:

Michelle Knaggs
Stephanie Wall
Eric Brownrigg
Fish, Wildlife and Recreation Program
British Columbia Institute of Technology

Draft 2 – March 2005

Abstract

Under Canada's Species at Risk Act (SARA) mountain beavers (*Aplodontia rufa rufa*) are designated as a species of Special Concern, and in the province of British Columbia are a red-listed species because of its limited distribution in BC. Because little is known about the mountain beaver's habitat, the purpose of this project was to compare relative abundance of mountain beavers, using burrow counts, in young and mature forests. Our study was done on Sumas Mountain, the western edge of their distribution from October 2004 to March 2005. Mountain beavers were only found in young stands. There was no evidence of mountain beaver activity in the mature stands, which suggests that mountain beavers are an early seral stage species.

Acknowledgements

We would like to thank the Ministry of Water, Land and Air Protection for providing us with trapping permit issued in late November, 2004. As well as Dr. Doug Ransome for spending so much time assisting us with our project and providing us with the necessary maps and references. We would also like to thank Neil Hughes for his interest in our project as well as for the valuable information and maps he provided. Also imperative to our studies were the forest cover maps supplied by the Chilliwack Forest District. As well we would like to thank Daryl Kelleher for providing us with some site recommendations and maps for Sumas Mountain. Another thank you goes out to the Fraser Valley Regional District (FVRD) Parks Manager Doug Wilson for allowing us to conduct our research within Sumas Mountain Regional Park. We also wish to thank fellow classmates who assisted us in setting up our traps, and checking our traps with us: Carlo Acuna, Steve Symes, Stacie Kalyn, Vanessa McGivern, and Judy Wall.

Table of Contents

List of Figures

List of Tables

1.0 Introduction

There are two subspecies of mountain beavers endemic to British Columbia. *Aplodontia rufa rufa*, which lives west of Hope and is red listed, and *A. r. rainieri*, which is blue listed and is found east of Hope. Mountain beavers are considered a species of Special Concern under the national Species at Risk Act (SARA) Schedule 1. Species of Special Concern are species that may become threatened or endangered because of a combination of biological characteristics and identified threats (Environment Canada, 2001). A management plan is required for all species on Schedule 1 of SARA. Consequently on Friday November 19, 2004 development of a Management Plan was initiated (Ransome, pers. comm.). Once completed, the Management Plan will assist land managers and wildlife biologists in managing mountain beavers in BC.

Mountain beavers are the most primitive rodent in the world, and their underdeveloped kidneys cannot process wastes efficiently. To eliminate body wastes, they must consume large quantities of water, which they get from open water and the food they eat (Carraway and Verts, 1993). Unlike any other animal, mountain beavers can survive entirely on sword fern (*Polystichum munitum*) and bracken fern (*Pteridium aquilinum*), and will eat most deciduous plants and other ferns (Cafferata, 1992; cf. Lindgren and Sullivan, undated). Before moving food into their burrows, they leave piles of plant clippings outside their main burrow entrance to dry for a couple of days (Figure 1) (Lindgren and Sullivan, undated). When all other deciduous plants have disappeared, mountain beavers will eat small conifers, which hinder replanting efforts and are the reason for their pest status in Washington and Oregon (Coblentz and Hacker, 1993).

Figure 1: Thimbleberry leaves clipped and placed near a burrow by a mountain beaver in Chilliwack, British Columbia (fall 2004).

Suitable forage must be available within 50 m of the mountain beaver's tunnel system (Gyug, 1999). Mountain beavers are fossorial and build extensive borrowing systems, which may include dozens of entrances and runways. They build separate underground chambers for nesting, storing food, and depositing wastes in deep soil and under small or large woody debris. Solitary and active year round, they typically do not travel far from their burrows, except during breeding season when males may travel up to 110 m from their nest sites in search of females (Lindgren and Sullivan, undated).

Mountain beavers in British Columbia can be found from Sumas Mountain in the Lower Fraser Valley to west of Merrit and south of the Fraser River (Figure 2). Mountain beavers live in the Engelmann Spruce Subalpine fir, Mountain

Hemlock, Coastal Western Hemlock, Montane Spruce, and Interior Douglas-fir biogeoclimatic zones (Meidinger and Pojar, 1991). They are also found throughout Northern California, Oregon and Washington (Carraway and Verts, 1991). The zone of integration is not clear because there has only been one study on their distribution (Ransome, 2003). About 10,000 ha, or one percent of British Columbia, is known mountain beaver range (Gyug, 1999).

There is relatively little known about the mountain beaver in British Columbia, including their complete distribution, critical habitat and effects of herbicide application and other forestry practices on their population dynamics (Ransome, 2003). Mountain beavers in Washington and Oregon caused millions of dollars in damage to the forest industry (Evans, 1987 cf. Coblentz and Hacker, 1993). However damage caused by mountain beavers in British Columbia is poorly documented. In addition, the role mountain beavers play in an ecosystem is not known.

It has been suggested by some interest groups that mountain beavers inhabit mature forest stands (Ransome, pers. comm.). Thus, harvesting mature stands may have a negative impact on mountain beavers. Although most authorities agree that mountain beavers obtain their highest densities in early seral stands (Carraway and Verts, 1991), this has not been formally documented. Therefore, objectives of our study were to determine and compare relative abundance of mountain beavers in young and mature forest stands. Vegetation analysis was conducted to develop habitat associations and species lists of preferred food items.

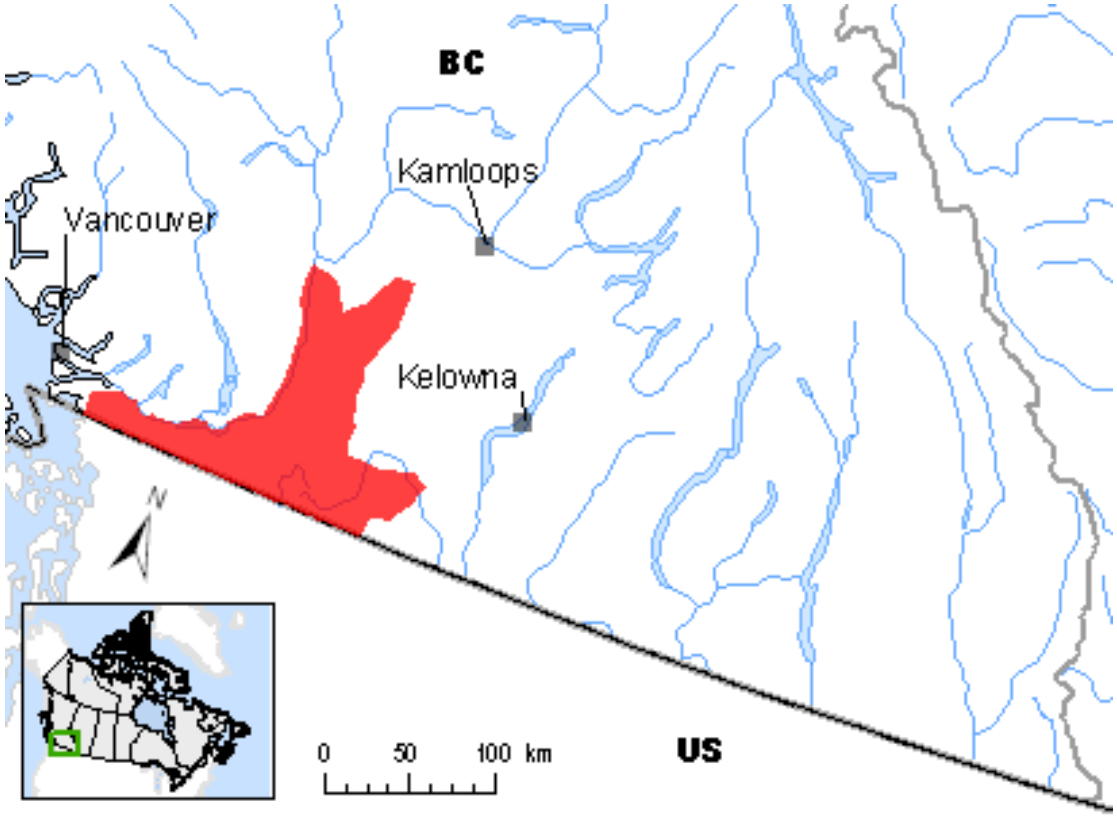

Figure 2: Distribution of mountain beavers in British Columbia (source: Environment Canada)

2.0 Study Area

Study areas were located on Sumas mountain in Abbotsford, B.C. (Figure 3). This mountain was once flanked by Sumas lake to the south-east and the Fraser river to the north. Sumas lake was drained in the 1920's to create an agricultural land base for the many farmers that were beginning to populate the area, as well to create an easier over-land transportation route (Figure 4). Extensive logging has occurred on the mountain.

Parts of Sumas mountain are used for forestry, agriculture, industry and residential development. A portion of the eastern side has been set aside as Sumas Mountain Regional Park (Figure 5). Since most of the eastern side has not been developed there are numerous mountain bike, 4x4, and hunting trails.

Figure 3: Location of Sumas mountain in relation to Abbotsford, Chilliwack and Mission (source: www.mapquest.ca).

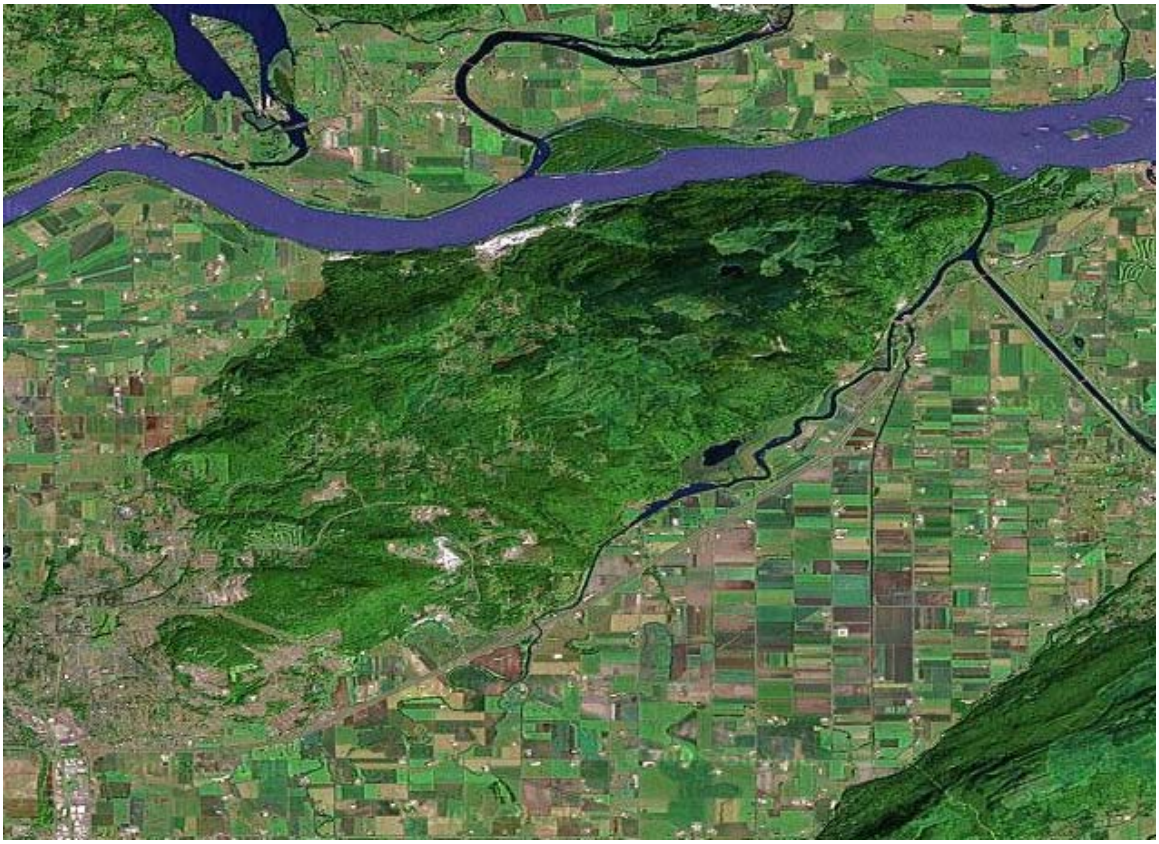

Figure 4: Satellite image of Sumas mountain and surrounding farmland (source: Google Maps)

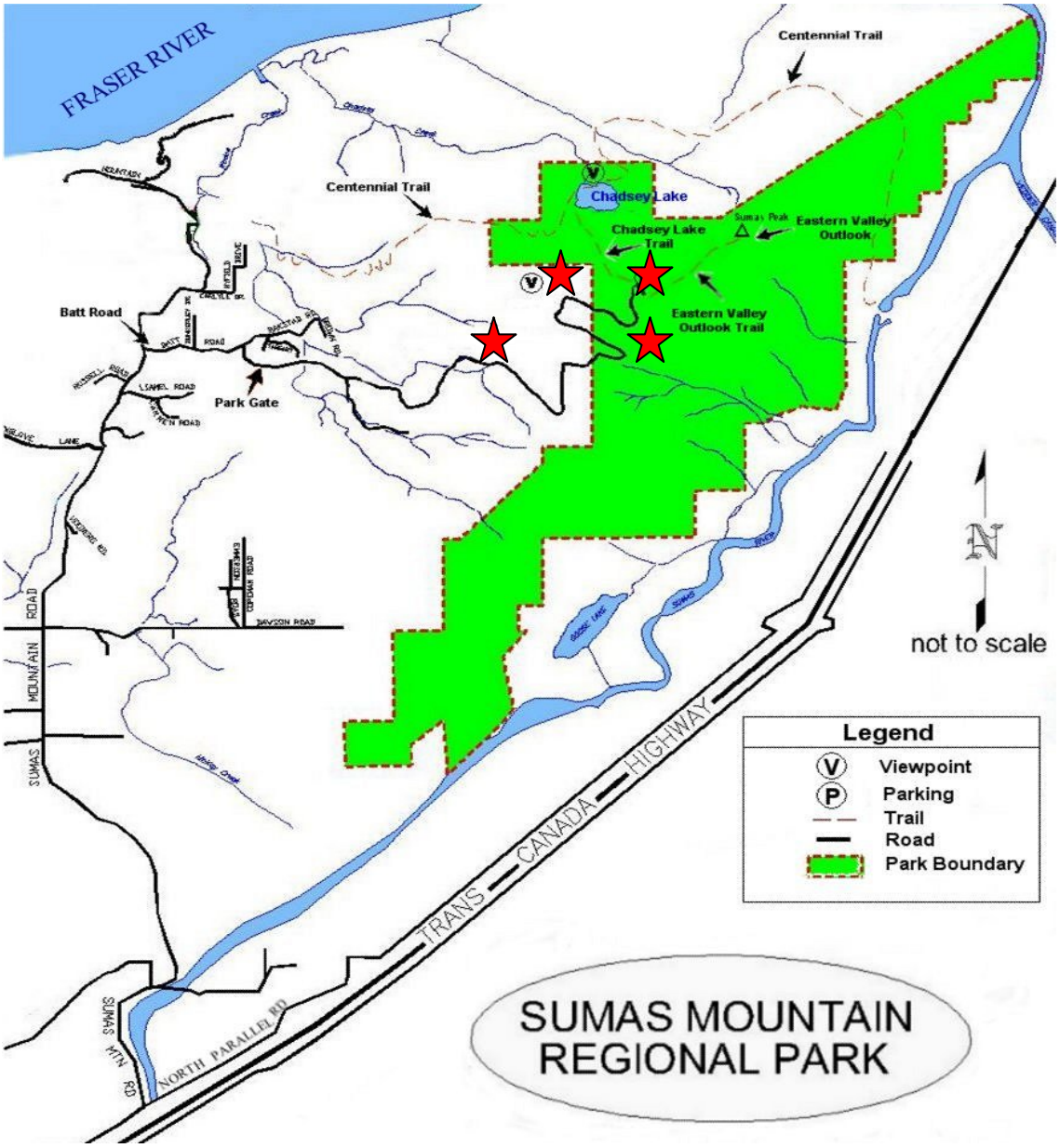

Figure 5: Map of Sumas mountain Regional Park and study sites (red stars).

We had four study blocks on the mountain, with two mature stands placed in Sumas Mountain Regional Park. Two young stands were approximately 5 ha in size, while the two mature stands were 9 and 39 ha in size; none of these stands were herbicided. Sumas Mountain is located within the Coastal Western Hemlock (CWH) biogeoclimatic zone (Meidinger and Pojar, 1991). This zone is the rainiest biogeoclimatic in British Columbia. Mean annual temperatures are about 8^{o}C and ranges from 5.2 to 10.5^{o}C in subzones. Mean annual precipitation

in the zone as a whole is 2228 mm and ranges from 1000 to 4400 mm. In the south where Sumas mountain is located as little as 15% of precipitation falls as snow. Dominant trees found in the CWH were western hemlock (*Tsuga heterophyla*), Douglas-fir (*Pseudotsuga menziezii*), western red cedar (*Thuja plicata*), amabilis fir (*Abies amabilis*), and bigleaf maple (*Acer macrophylum*). Salmonberry (*Rubus spectabilis*), Vaccinium species (*Vaccinium* spp.), devil's club (*Oplopanax horridus*), sword, bracken and deer fern (*Blechnum spicant*) were common understory plants (Meidinger and Pojar, 1991).

Research Block 1 was located about 2.5 km up Sumas FSR. It was logged in 1994, planted with Douglas-fir, western red cedar and western hemlock in 1994 till 1996, and brushed in 1999. This block was dominated by vine maple (*Acer circinatum*) and red alder (*Alnus rubra*). Salmonberry and huckleberry (*V. parvifolium*) dominated the understory. Herb layer primarily contained sword fern and bracken fern. Topography within the block varied from rocky outcrops to seepage sites and dense brush. Approximately one quarter of the northeast corner of the block contained a northeasterly facing slope exceeding 65% grade. This portion was not sampled as it was too dangerous. This block was surrounded by two Age Class 5 stands (81-100 years old) and an age class 4 (61-80 years old) stand. Understory was dense throughout with exception of a few areas that contained thin soil and rocky characteristics.

Research Block 2 was 6 km up Sumas FSR. This site was logged in 1989, planted with Douglas-fir and western hemlock the following year and brushed in 1997. Block 2 was dominated by Douglas-fir, red alder, and amabilis fir. Shrubs consisted of red huckleberry and salmonberry. Sword and bracken fern dominated the herb layer. It was a relatively flat block with some rocky outcrops.

Research block 3 and 4 were approximately 9 and 11 km, respectively, up Sumas FSR. Both were age class 8 stands (141-200), and were within Sumas Mountain Regional Park. They were fairly uniform stands with Douglas-fir,

amabilis fir and western hemlock dominating the tree layer. On the forest edge where it was bordered by a road, western hemlock, amabilis fir and red huckleberry dominated the understory layer. Remainders of the stands were primarily mosses as very little light penetrated the canopy. Block 3 was fairly flat, with numerous pools and rocky outcroppings. Block 4 had a northerly aspect and a slope of 25^{o}.

3.0 Methods

3.1 Burrow Counts

We studied the relative abundance of mountain beavers in both young and mature stands. To conduct this research we used line transects with point samples following Inventory Methods for Mountain Beavers, Bushy Tailed Woodrats and Porcupines (RISC # 27). The start points for all four blocks were randomly selected prior to the start of research and bearings were chosen in the field to ensure adequate coverage of the block.

All start points were located near roads and the first plot centers were located 25-m along the pre-determined bearing. All other plots followed the same bearing, but were spaced 50-m apart from each other (Figure 6). Twenty plots were surveyed in each block. We recorded burrows, vegetation piles, runways, damaged vegetation and special site characteristics for each 10-m radius plot. Burrows were categorized as fresh (recent digging or vegetation piles), old (in tact but no sign of recent use) or collapsed (entrance caved in). Runways were also counted. Species of vegetation damaged by mountain beavers was recorded. Special features, such as streams, roads, and rocky outcrops were noted.

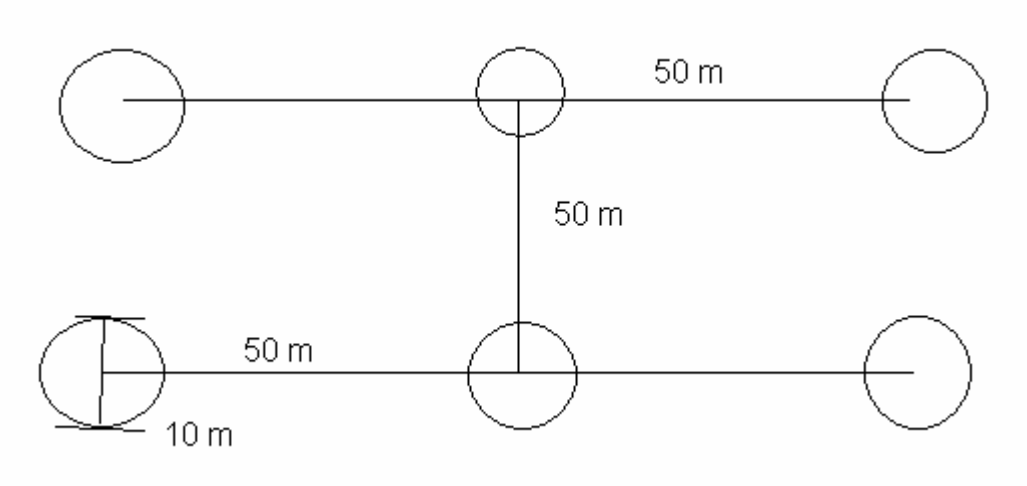

Figure 6: Burrow count sample design

3.2 Trapping

Live trapping was completed in young stand two following RISC standards manual # 27. Tomahawk 201 live traps were set on a grid eight rows wide and 30-m apart from each other. Seven traps were spaced 30-m apart on each line, for a total of 56 traps (Figure 7). Traps were pre-baited and locked open on December 13 and 22, 2004 and on January 11, 2005 with whole apples. Traps were set in late afternoon before dark and checked the next morning. Mountain beavers caught were ear tagged, sexed and weighed (Figures 8, 9 and 10). One-night trap sessions were conducted on January 25, February 27 and March 6, 2005. A single day trap session was conducted on March 6 in addition to night trapping.

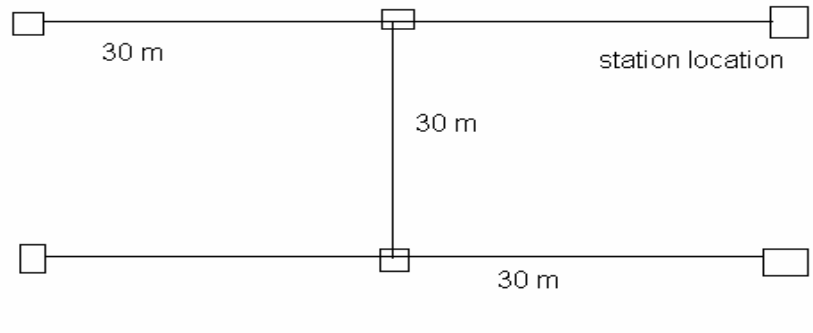

Figure 7: Trap layout design

Figure 8: Transferring a mountain beaver from a live trap into a net bag

Figure 9: Ear tagging a mountain beaver

Figure 10: Weighing a mountain beaver in a net bag

For the duration of our trapping sessions we attempted to walk the same lines throughout the study in order to reduce disturbance to burrows. When trapping was conducted we spent as little time as possible at the traps to minimize disruption. When caught mountain beavers they were handled by one or two people to reduce the amount of stress and time spent in the net bag.

3.3 Vegetation

Four vegetation plots were surveyed in each block. Percent cover was measured for trees, shrubs, and herbs. Trees were measured in a 5.64 m radius plot, 2.82 m radius for shrubs, and 1.26 m radius for herbs.

4.0 Results

4.1 Burrows

No mountain beaver burrows or sign were found in mature stands. Numerous mountain beaver burrows were found throughout the young stands (Table 1). Burrows were found near water, deep soil, abundant food supply, and none were found in rocky areas. More than one burrow was found at each station. Sword fern and western hemlock were plant species most often found clipped near burrow entrances.

Table 1: Comparison of total burrows counted (runways and caved, old, and fresh burrows) between young and mature stands on Sumas mountain, British Columbia, 2004 – 2005.

Study Site	Total burrows found
Young # 1	186
Young # 2	95
Mature # 1	0
Mature # 2	0

When analyzing the data, we calculated 95% confidence intervals. Young stand one had almost twice as many burrows as young stand two (Figure 11). However, young stand one had half as many plots which resulted in a larger range than young stand two when calculating the number of burrows per hectare (Figure 12).

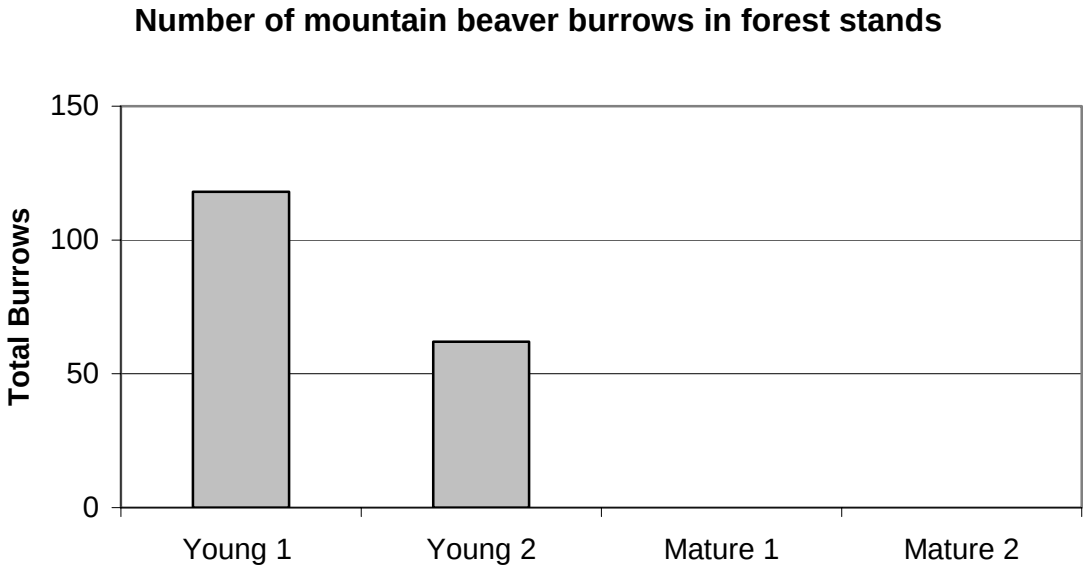

Figure 11: Comparison of mountain beaver burrows counted in young and mature stands

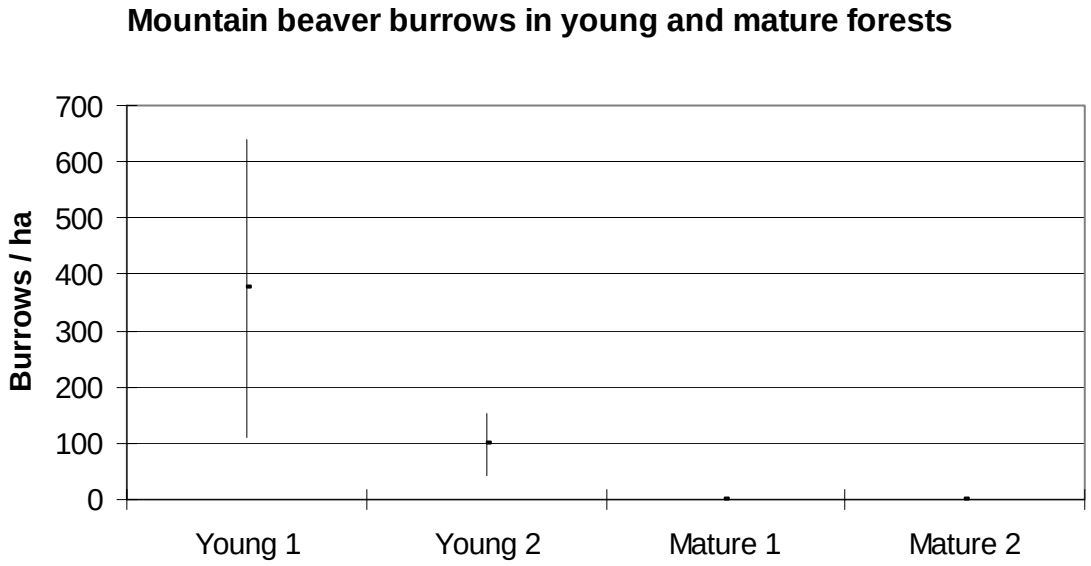

Figure 12: Comparison of burrows per hectare in young and mature stands

Figure 13: Mountain beaver burrow on Sumas mountain, BC in winter 2005

4.2 Trapping

Three trap sessions were conducted, and two mountain beavers were caught during two separate sessions. First mountain beaver was caught on January 25, 2005 at station C6 (Figure 14). This mountain beaver weighed one KG. Gender was not determined as it was extremely difficult to tell. Second mountain beaver was caught on March 6, 2005 at station G2 and weighed one KG and again gender was difficult to determine (Figure 15).

Figure 14: Mountain beaver caught at station C6, on January 25, 2005

Figure 15: Mountain beaver caught at station G2, on March 6, 2005

4.3 Vegetation

Canopy closure was significantly higher in mature stands compared to young stands (Figure 16). In our young stands the percent cover of shrubs was much higher than in the mature stands (Figure 17). Some common shrubs and trees found in the young stands were elderberry, salmonberry, thimbleberry, Vaccinium spp., western hemlock and Douglas-fir. Some common shrubs and trees found in the mature stands were Vaccinium spp., and Douglas-fir, amabilis fir and western hemlock (Table 2).

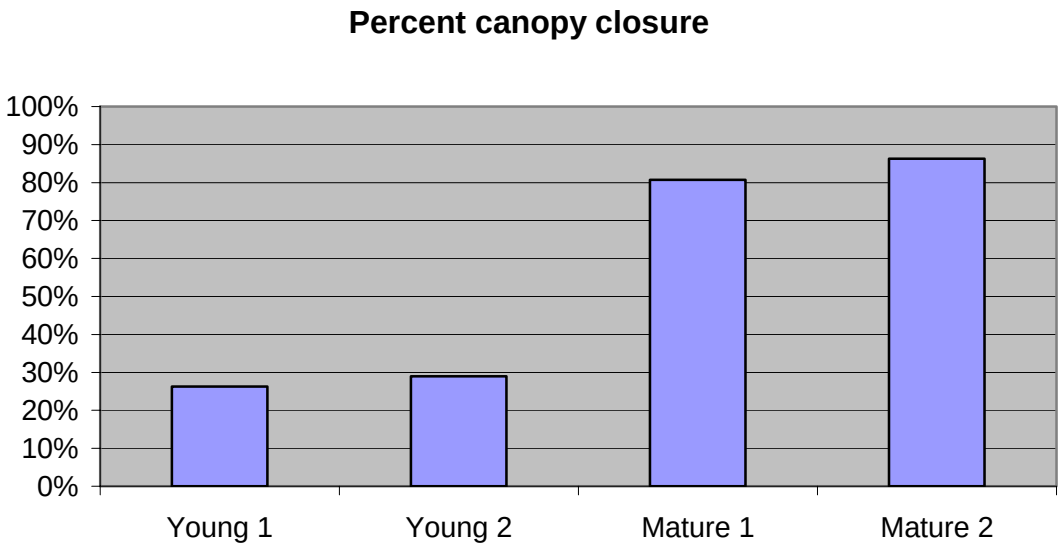

Figure 16: Comparison of canopy closure between young and mature stands

Table 2: Average percent cover (n=4) of vegetation plots

	Young		Mature	
Species	**1**	**2**	**1**	**2**
Western Hemlock	3%	19%	81%	79%
Amablis Fir	0%	7%	5%	2%
Douglas-fir	20%	2%	0%	1%
Western red-cedar	3%	2%	0%	0%
Red Alder	40%	39%	0%	0%
Vaccinium spp.	10%	6%	18%	24%
Salmonberry	38%	35%	0%	0%
Devil's Club	0%	1%	0%	0%
Gooseberry	1%	0%	0%	0%
Bracken fern	15%	16%	0%	0%
Willow	4%	0%	0%	0%
Vine Maple	4%	0%	0%	0%
False Azalea	0%	0%	1%	0%
Thimbleberry	3%	0%	0%	0%
Elderberry	5%	0%	0%	0%

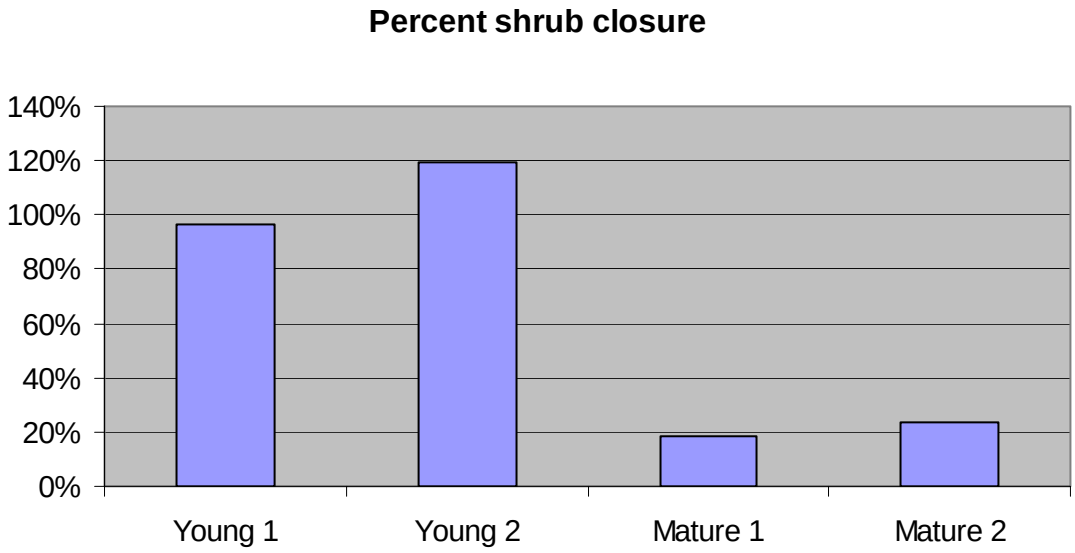

Figure 17: Comparison of shrub closure between young and mature stands

5.0 Discussion

In our mature stands we found no evidence of mountain beaver. Both stands had closed canopies with little understory vegetation. We found all mountain beaver sign in the young stands which had abundant deciduous and coniferous shrub growth. Therefore, we can conclude that a lack of suitable vegetation prevented mountain beavers from living in closed canopy forests. Based on the data we have collected, mountain beavers depend on openings in the forest canopy which encourage abundant vegetative growth.

We have observed that mountain beavers use coarse woody debris (CWD) as cover. We noticed that wherever possible runways were placed next to or under CWD. Based on these observations we concluded that CWD is essential as cover for mountain beavers. Since we observed more CWD in young stands than in the mature stands this could be another contributing factor as to why mountain beavers preferred younger forests.

Most of the vegetation found in young stands consisted of large shrubs and coniferous trees. Open canopy of these stands promoted the growth of plants such as salmonberry, thimbleberry, bracken fern, sword fern and various Vaccinium species. These plants are sought after by the mountain beaver once they green up as they provide them with much needed moisture as well as vitamins and minerals (Carraway and Verts, 1993).

Young stand one had more suitable mountain beaver habitat because of the moderate to steep slope and running water. In Beier's study (1993) reaches with mountain beavers had steeper gradients and narrower and shallower streams. Young stand two was relatively flat, had standing water and numerous rocky outcroppings.

There was a larger confidence interval for young stand one because there was a wider ranger of burrows counted per plot. For example a plot would contain no burrows, while another had 31 burrows per plot. This range of burrows was compounded when we extrapolated these data to burrows per hectare.

Because we had such low success with trapping we cannot compare the number of burrows counted to the number of beavers captured. Although we caught very few individuals, this may not indicate trapability. There were many factors that could have caused them to be less trappable; such as snow and cold temperatures, lack of frequent pre-baiting and trap distribution. Black (1979) noticed that success rate was lowest in autumn and winter. In his 2003 study D. Ransome (pers. comm.) found that mountain beavers were quite trappable. In this previous study traps were placed at burrow entrances. Black (1979) used a rotational trap system, meaning he moved traps every week from one station to the next every week and returning to the first station every five weeks. However, in our study traps were placed on a grid every 30 m to accurately document movement and home range. When possible traps were placed at burrow entrances.

There has been concern that mountain beavers may be impacted by trapping through accidental trampling of their burrows while checking traps. However, during our study we found that very few burrows collapsed. Each day we pre-baited or trapped we walked the same lines but even when a burrow was accidentally damaged we noticed that it was repaired and use of the burrow was continued.

During our study, we counted burrows and trapped in sun, rain and snow. We did not notice above ground movement of mountain beavers when it snowed. No tracks were noted and vegetation around burrow entrances was either old or covered in snow. After snow had melted, numerous tunnels and fresh kickouts (recent burrow excavations) were observed. We believe that on Sumas

mountain, mountain beavers remain active under the snow but are not active on the surface, and as soon as the snow melts mountain beavers emerge from their burrows and above ground activity resumes.

6.0 Recommendations

To improve trapability, we should deposit apples inside burrows in addition to pre-baiting traps. Trapping may also be more successful before snow and cold temperatures arrive. Rather than placing traps systematically, placing them in optimal mountain beaver habitat may result in more animals captured. Traps placed systematically often were not in suitable mountain beaver habitat, such as on rocky outcrops or areas with shallow soil. Traps should be positioned as close to a burrow entrance or runway as possible. Experimenting with other trap methods could increase captures.

It is recommended when checking traps to use the same pathway each time to avoid potential trampling of burrows, however we did not observe much of this. Although over the short term this did not appear to affect mountain beavers, consequences of long term trampling are unknown.

Since mountain beaver activity is low during the fall and winter trapping should be conducted in spring and summer. However, since females are susceptible to trap death in spring when they are possibly pregnant or have had young, we recommend that trapping be done exclusively in summer (Ransome pers. Comm.).

Considering that mountain beavers prefer lush vegetation and running water, it is recommended that openings in the forest canopy be maintained to encourage such growth of vegetation.

We also recommend that future studies focus on mountain beavers use of coarse woody debris and effects that brushing and herbiciding cut-blocks have on mountain beaver population dynamics.

7.0 Literature Cited

Beier, P. 1993. Use of habitat by mountain beaver in the sierra Nevada. Journal of Wildlife Management. 53(3): 649-654

Black, H. and Lovejoy, B. 1979. Movements and home range of the pacific mountain beaver, *Aplodontia rufa pacifica*. The American Midland Naturalist. 101(2): 394-402

Carraway, L.N. and Verts, B.J. 1993. Mammalian Species – *Aplodontia rufa*. American Society of Mammalogists 431: 1-10pp

Coblentz, B.E. and Hacker, A.L. 1993. Habitat selection by mountain beavers recolonizing Oregon Coast Range clear cuts. Journal of Wildlife Management 57: 847-852.

Environment Canada. 2001. Species at Risk – Mountain Beaver < http://www.speciesatrisk.gc.ca/search/speciesDetails_e.cfm?SpeciesID=333 > Accessed 2004 27 Nov

Gyug, L.W. 1999. COSEWIC status report on mountain beavers. Committee on the Status of Endangered Wildlife in Canada, Ottawa, Ont. 23pp.

Lindgren, P. and Sullivan, T. Undated. Standardized Methodologies for the Inventory of Components of Biodiversity. Department of Forest Sciences, University of British Columbia.

Ministry of Environment, Lands and Parks, Resources Inventory Branch. 1998. Inventory Methods for Mountain beaver, Bushy-tailed Woodrat and Porcupine. Standards for Components of British Columbia's Biodiversity No. 27

Meidinger, D. and Pojar, J. 1991. Ecosystems of British Columbia. BC Minitry of Forests.

Ransome, D. 2003. Distribution, population dynamics, habitat associations, and the influence of forest management on mountain beavers. Project Report # R2003-1023. Forestry Innovation Investment.

Appendix 1 – Data collection forms

Table 3: Mountain beaver burrow counting data collection form

Block #	Station #	1	2	3	4	5	6
Date							
Burrow	Caved						
	Runway						
	Fresh						
	Old						
Vegetation							
	Deciduous						
	Coniferous						
	Shrub						
	Fern						
Comments							

Table 4: Species code identification for completed data forms

Vegetation Code	
Species	**Code ID**
Western Hemlock	Wh
Amablis Fir	AbF
Douglas-fir	Df
Western red-cedar	WC
Red Alder	AlRa
Vine Maple	ViMa
Vaccinium spp.	Vacc.
Salmonberry	SaBr
Thimbleberry	ThBr
Gooseberry	GsBr
Dull-oregon grape	DuGr
Sword fern	SwFr
Bracken fern	BrFr

Table 5: Vegetation data collection form

	Stand #			
	Date: _____ Wx: _____			
Species	Plot 1	Plot 2	Plot 3	Plot 4

Table 6: Mountain beaver trapping data form

Date	**Line & Station #**	**Tag #**	**Sex**	**Weight**	**Other species**

Appendix 2 – Completed burrow count data collection forms

Block 1 - Young # 1	Station #	1	2	3	4	5	6	7	8	9	10
Date	Nov 24, 04										
Burrow	Caved	4	3	0	0	3	0	0	1	3	0
	Runway	20	13	7	0	10	3	1	10	2	0
	Fresh	15	11	4	0	6	3	0	9	0	0
	Old	12	17	9	0	10	2	0	5	3	0
Vegetation											
	Deciduous	ViMa, AlRa				AlRa	AlRa				
	Coniferous		Wh						DfWh		
	Shrub	SaBr	SaBr	SaBr, ThBr			SaBr(lots)				
	Fern	SwFr	SwFr			SwFr		SwFr	SwFr	SwFr	
Comments - this block only has 10 station because about 50% of the block is a very steep slope, it was too dangerous to sample on		creek running through old burrow systems		1 burrow and runway system under water	On bedrock, very shallow soil	lots of bracken fern and devils club, hard to see under all of it	part of plot falls on the road	Last station was skipped because it fell within a mature stand		adjacent to a large landing (size = ?) with a road running east/west	at the northern corner of a large landing, shallow rocky soil

Block 2 - Mature stand # 1	Station #	1	2	3	4	5	6	7	8	9	10
Date	Nov 19, 04										
Burrow	Caved										
	Runway										
	Fresh										
	Old										
Vegetation		little light reaching the forest floor, very little forage for mountain beavers, very little available CWD									
	Deciduous										
	Coniferous										
	Shrub										
	Fern										
Comments		No evidence of mountain beavers was found in this study area.									

11	12	13	14	15	16	17	18	19	20
lack of CWD resulted in no hiding places for the mountain beavers									
No evidence of mountain beavers were found in this study area.									

Block 3 - Young # 2	Station	1	2	3	4	5	6	7	8	9	10
Date	25-Mar-05										
Burrow	Caved	0	1	no mountain beavers	0	0	0	0	no mountain beavers	0	0
	Runway	3	3		2	0	4	2		1	1
	Fresh	2	6		1	0	2	0		2	0
	Old	0	1		0	2	8	1		2	1
Vegetation											
	Deciduous										
	Conifer						WH				
	Shrub										
	Fern						SwFr				
Comments		There was a pond in the corner, and the area surrounding it was very rocky	a bit of snow on the ground made ID a bit difficult	plot centre was on a large rock outcrop	deep snow and thick dead bracken fern made ID difficult	deep snow	a portion of the plot was rocky, snowy, and there was a pond in XXXXX	deep snow	near a road, very rocky		there was a small pool of water in a potion of the plot

11	12	13	14	15	16	17	18	19	20
2	1	no mountain beavers	no mountain beavers	0	2	0	0	no mountain beavers	no mountain beavers
1	2			2	7	4	1		
2	0			3	6	0	0		
2	1			3	5	4	2		
					WH				
					SwFr				
	ID hampered by snow	very dense western hemlock stand	more dense stand, edge of a rocky outcrop	road through 50% of plot	snow, road through 50% of plot,	45% of plot is road	spur road over 15% of plot, little vegetation	large rocky outcrop over entire plot	road over 50% of plot and dense stand other 50%

Block 4 – Mature stand # 2	Station	1	2	3	4	5	6	7	8	9	10
Date	Dec 1, 04										
Burrow	Caved										
	Runway										
	Fresh										
	Old										
Vegetation		closed canopy above prevented much light from getting to ground, therefore there is little forage for mountain beavers									
	Deciduous										
	Coniferous										
	Shrub										
	Fern										
Comments		No mountain beavers were found									

NOTE: There were 10 plots studied in Block 4 and Block 1, and 20 in Block 2 and 3 for a total of 30 plots in young and old stands. This helped us compare it all easier.

Appendix 3 – Completed vegetation plot data collection forms

	Young Stand #1			
	Date: March 25, 2005 Wx: Rainy			
Species	Plot 1	Plot 2	Plot 3	Plot 4
Western Hemlock	1%	5%	0%	7%
Douglas-fir	15%	10%	25%	30%
Western red-cedar	< 1%	< 1%	3%	< 1%
Willow	15%	0%	0%	0%
Red Alder	1%	95%	35%	30%
Elderberry	20%	0%	0%	0%
Salmonberry	75%	< 1%	< 1%	0%
Thimbleberry	5%	< 1%	< 1%	1%
Gooseberry	2%	0%	< 1%	< 1%
Bracken fern	10%	50%	0%	0%
Vine Maple	15%	0%	0%	0%
Vaccinium spp	0%	5%	10%	25%

	Young Stand #2			
	Date: March 25, 2005 Wx: Rainy			
Species	Plot 1	Plot 2	Plot 3	Plot 4
Western Hemlock	30%	5%	30%	10%
Amablis Fir	5%	< 1%	5%	10%
Douglas-fir	2%	0%	1%	5%
Western red-cedar	1%	0%	0%	5%
Red Alder	20%	45%	15%	75%
Vaccinium spp.	5%	0%	5%	15%
Salmonberry	0%	65%	10%	65%
Devil's Club	0%	0%	2%	0%
Gooseberry	0%	0%	< 1%	0%
Bracken fern	0%	0%	65%	0%

	Mature Stand #1			
	Date: March 25, 2005 Wx: Rainy			
Species	Plot 1	Plot 2	Plot 3	Plot 4
Western Hemlock	85%	75%	85%	80%
Amablis Fir	< 1%	5%	< 1%	< 1%
Vaccinium spp.	< 1%	< 1%	5%	30%
False Azalea	0%	0%	< 1%	0%

	Mature Stand #2			
	Date: March 25, 2005 Wx: Rainy			
Species	Plot 1	Plot 2	Plot 3	Plot 4
Western Hemlock	90%	75%	75%	75%
Amablis Fir	< 1%	< 1%	3%	0%
Douglas-fir	1%	0%	0%	1%
Vaccinium spp.	30%	30%	25%	10%
Salmonberry	< 1%	< 1%	< 1%	0%
Gooseberry	0%	0%	0%	< 1%