

Risk Assessment of the Threat to Seedlings by Snowshoe Hares and Small Mammals in the 2010 Burned Stands



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Executive Summary

Under the right conditions snowshoe hares, and small mammals, can cause considerable damage-losses of planted seedling trees, and unfortunately these conditions are now occurring across large areas of the Nadina Forest District. Here a cyclic high in hare populations has coincided with optimum habitat conditions that support high hare densities, in areas which were burned in 2010. Across the forest harvest landbase in this Forest District, these large fires burned ~ 100,000 ha, and now replanting efforts are underway to re-establish young seral plantations partly, or entirely, lost due to the fires.

The risk to seedlings of damage-losses from hares or small mammals is in large part site specific dependent on the understory vegetation cover, the severity of the burn, the age of the stand, patch size and stand distance to areas with high densities of hares and small mammals.

Open sites, with low vegetation coverage (possibly also visible mineral soils) have low potential for snowshoe hare, or small mammal damage. Sites with high canopy closure, 25-50 years of age, with only very light canopy burn or small burn patches will have high risk of snowshoe hare damage. More open sites, particularly with intact high suitability hare habitat (25-50 years) nearby, may also see damage-losses of seedling. Small mammals may cause damage to seedlings planted in sites with a high coverage of grasses and seeding/fruited herbs and shrubs.

Due to the variety of site conditions, and the impact that the severity of fire has on the suitability of a stand to support snowshoe hares and small mammals, it is recommended that prior to planting sites are visited to assess the risk to the seedlings. These visits would look both at the specific site conditions, and look for hare and small mammal sign (browsing and pellets). Appendix 2, provides a risk assessment framework for seedlings to browsing by snowshoe hares. Unfortunately in the 3 years since the fire a robust vegetation community has established in the understory in many sites, which in some sites may be expected to support high numbers of small mammals.

For sites with high risk of browsing damage, protecting the seedlings, or removing the canopy and understory vegetation through brushing, or the application of herbicide may reduce that risk, but an alternative to this may be to leave planting of such sites until hare populations decline as part of the natural snowshoe hare cycle.

The current and future landscape conditions are such that this landscape is now becoming dominated by young seral forests which provide for high snowshoe hare suitability habitat. We may therefore expect to see an increasing numbers of hares and this may be expected to pose an increased threat of seedling damage or loss, particularly at the cyclic high in hare numbers. Management of successful seeding planting in the future may therefore have to consider both the timing of planting in relation to the peak in the hare cycle, and also the distance of planting from high suitability hare habitat.

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Acknowledgements

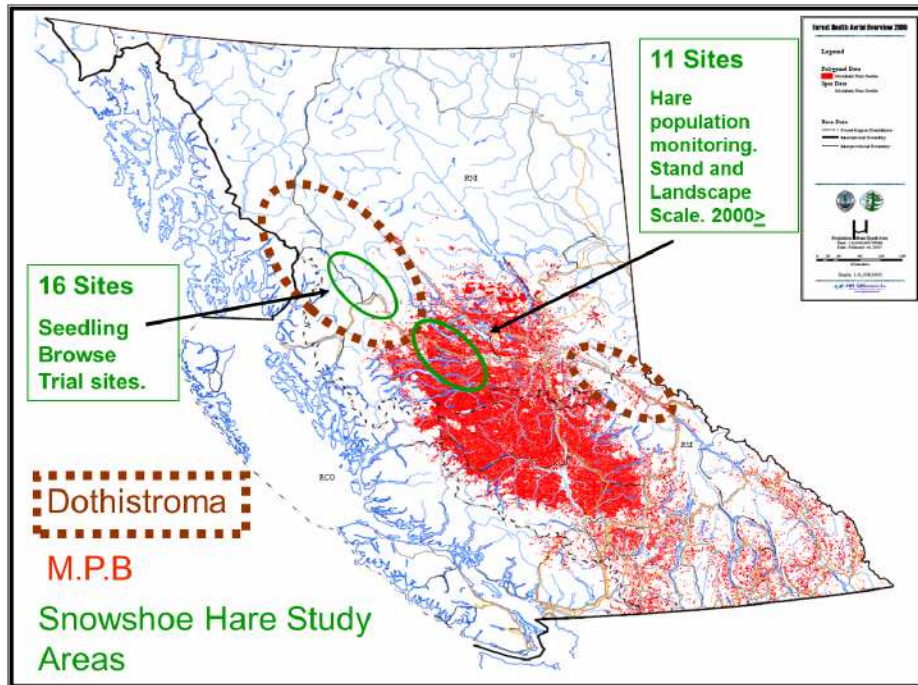
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Introduction

Over the past 30-40 years, across the Nadina Forest District and large areas of the adjacent Forest Districts in the Interior Central Plateau, we have seen dramatic changes in our forests. With a large shift in forest age distribution, a decline in forest health due to

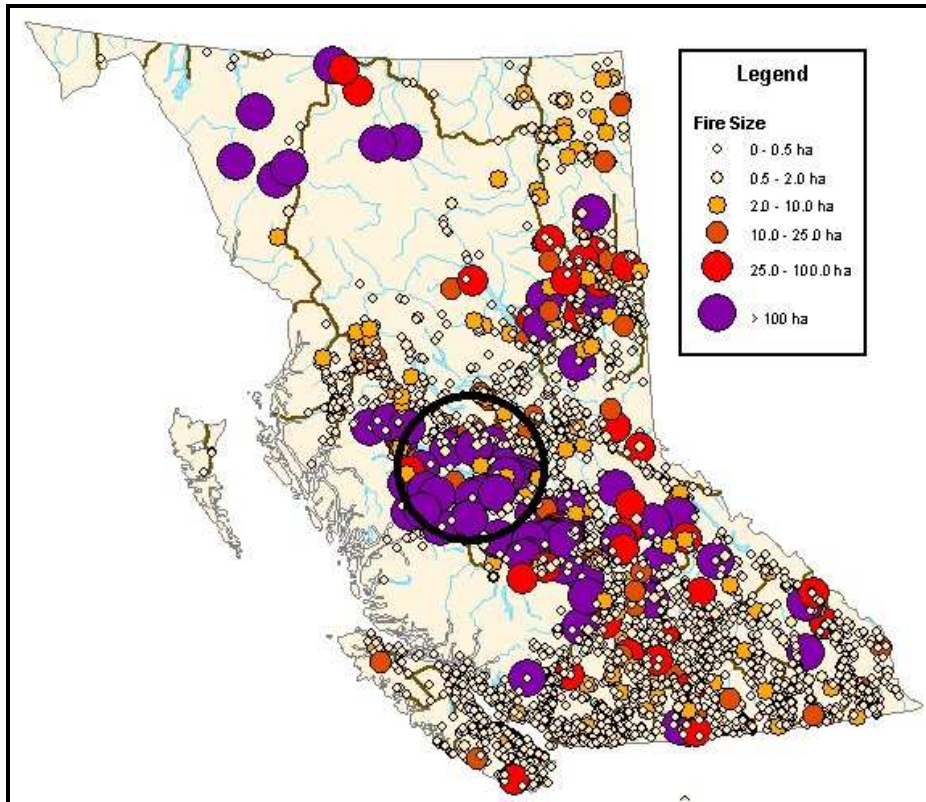
the Mountain Pine Beetle and foliar diseases (e.g. Dothistroma) (Map 1), and the loss of large areas of mature and second growth forests as a result of fire. In the Nadina Forest District alone in 2010, these fires burned across ~ 100,000 ha of forest (Map 2).

Map 1. Mountain Pine Beetle and Dothistroma attacked Pine Areas in central and northwestern BC, and the general location of long-term snowshoe hare monitoring sites and seedling browse trial sites.



Within this landscape the number of snowshoe hares and small mammals has continued to fluctuate and cycle in response to hard wired interactions between themselves, their food, and their predators. However, their numbers are also impacted by the seral stage distribution of suitable habitats, patch size, time since fire and annual weather. From a silvicultural perspective, long-term snowshoe hare monitoring has indicated that a peak in snowshoe hare numbers would occur sometime over the next few years (Doyle 2011). Unfortunately this peak in hare numbers is now coinciding with the onset of replanting planting efforts within the large areas impacted by fires (~100,000ha) across the Nadina, and many other interior Forest Districts in 2010.

Map 2. Forest Fire map of BC in 2010. (Dark circle indicates the approximate location of this assessment).



From the ongoing research-monitoring looking at the impacts of snowshoe hares on damage to, and survival of seedlings (Doyle 2011), we knew that site attributes (% cover, patch size, distance to high suitability habitat) all influenced the number of hares in any particular patch. The following assessment of sites that were identified for planting in 2013, was conducted to assess those site specific conditions (including hare density), and thus determine which blocks could be safely planted without an expectation of high seedling losses, and those sites where high seedling losses may be expected to occur. Further, we also made an assessment of the potential relative abundance of small mammals (based on the presence of cover, forage plants and observed vole/mice sign) within the target blocks, to determine next spring which sites could be planted without a risk of high seedling losses-damage by snowshoe hares.

Methods

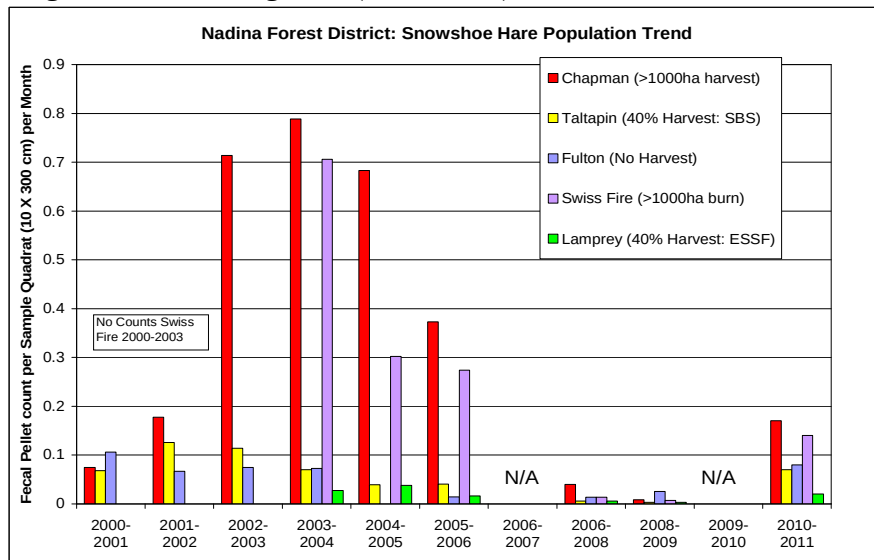
This assessment used both visual cues (snowshoe hare and vole/mice fecal droppings) and habitat suitability to determine the potential risk to seedlings of browsing damage. Snowshoe hare habitat suitability is based on observed habitat linkages in central-northwestern BC (Doyle 2008a), and small mammal suitability (Sullivan et al. 2000).

Results

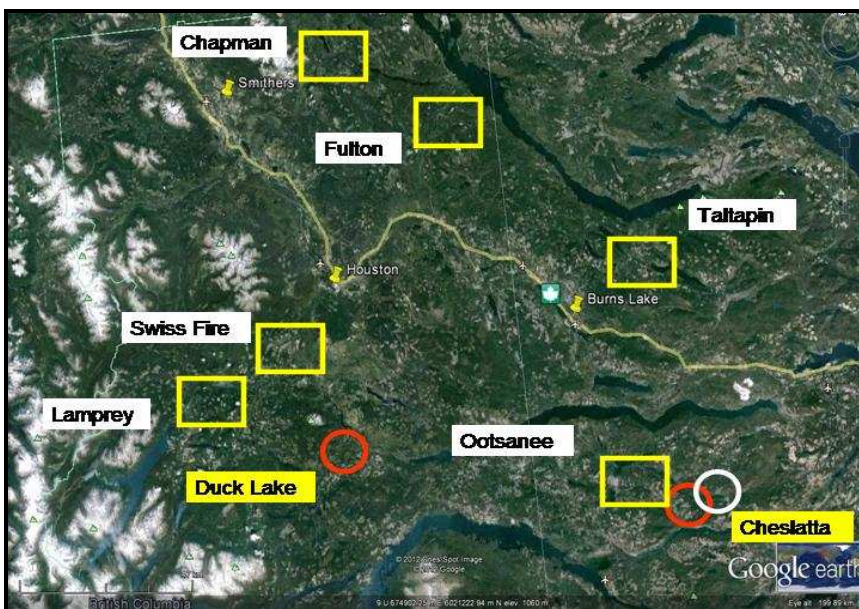
Overall Snowshoe Hare Population Trend

Looking at the larger picture across the Nadina and adjacent Forest Districts Snowshoe hare populations (2000-2011) appear to be on the increase phase of the hare cycle (Figure 1) (Map 3).

Figure 1. Relative abundance of Snowshoe Hares (using fecal hare pellet counts) across long-term monitoring sites (2000-2011) in central-northwestern BC.

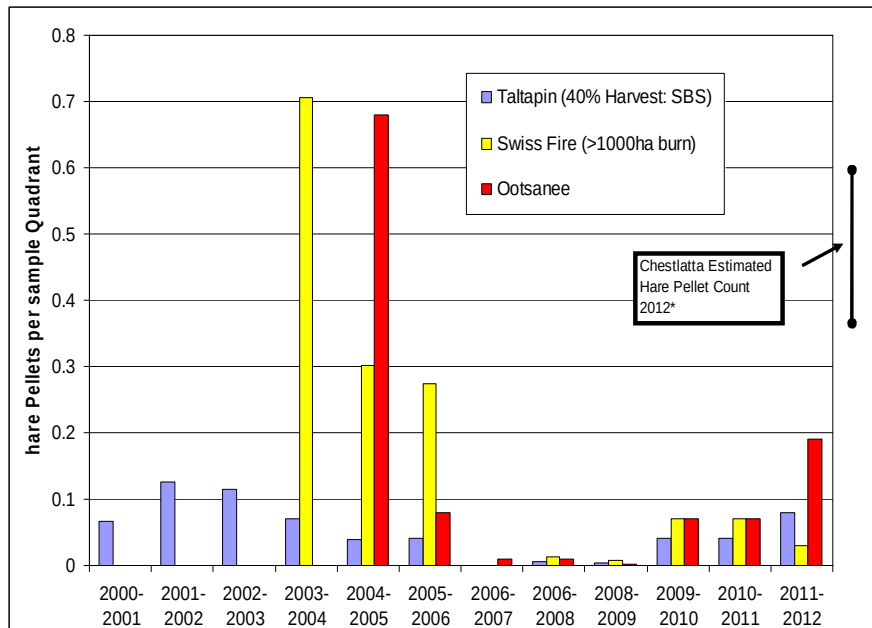


Map 3. Locations of long-term Snowshoe Hare monitoring sites (Squares) and focal seedling-snowshoe hare browse risk assessment sites (Circles).



Focusing specifically at the number of snowshoe hares in monitoring sites adjacent to the focal seedling-snowshoe hare browse risk assessment sites, we see the same trend in numbers from 2000-2012 (Figure 2, Map 3). This includes the estimated equivalent snowshoe hare density at Cheslatta (Appendix 1), where estimated hare densities are higher than observed in many of the longer-term monitoring sites.

Figure 2. Relative abundance of Snowshoe Hares (using fecal hare pellet counts) in monitoring sites (2000-2012) adjacent to the focal seedling-snowshoe hare browse risk assessment sites.



* Estimated based on total pellet counts and the observed range of hare pellet degradation rates.

Focal Seedling-Snowshoe Hare Browse Risk Assessment.

Looking more closely at two landscapes where fires (Binta and Poplar Lake) burned large areas of the forest harvest landbase in 2010, we see very different site specific snowshoe hare densities = seedling risk to browsing on a site specific basis.

In the area east of Duck Lake, 17 forest harvest patches were assessed to determine the potential threat of seedling browse based on snowshoe hare densities, and 5 sites had a high abundance of snowshoe hares (relative to the long-term monitoring sites), 6 moderate densities, and 5 sites low-nil densities (Map 4).

Map 4. Duck Lake area site specific seedling-snowshoe hare browse risk assessment sites (Circles: Red = high density, Green = moderate, White = low-nil).

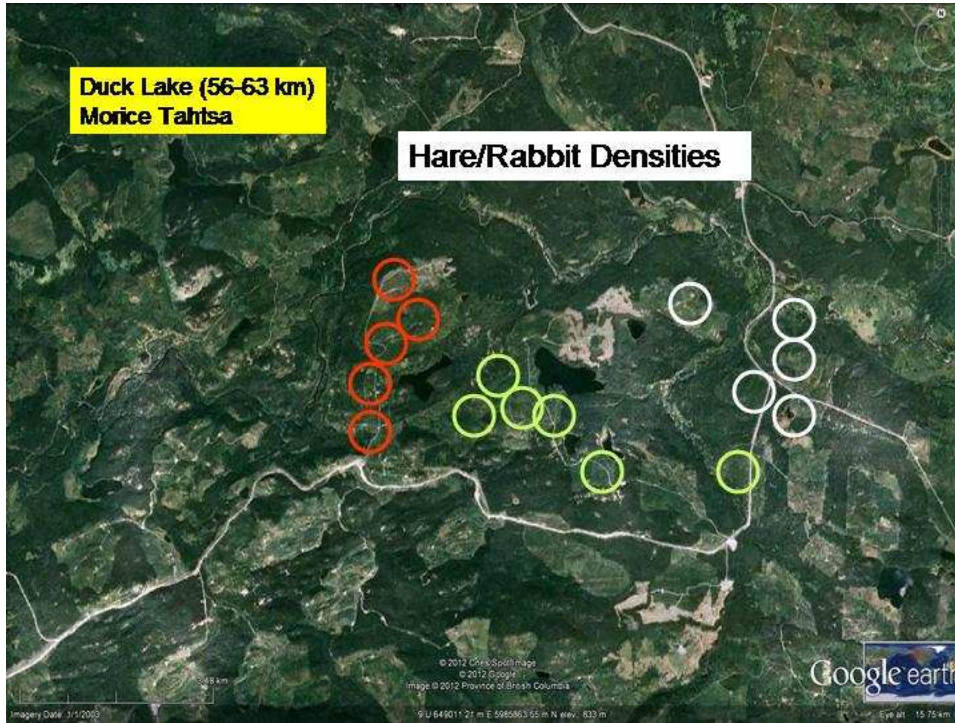
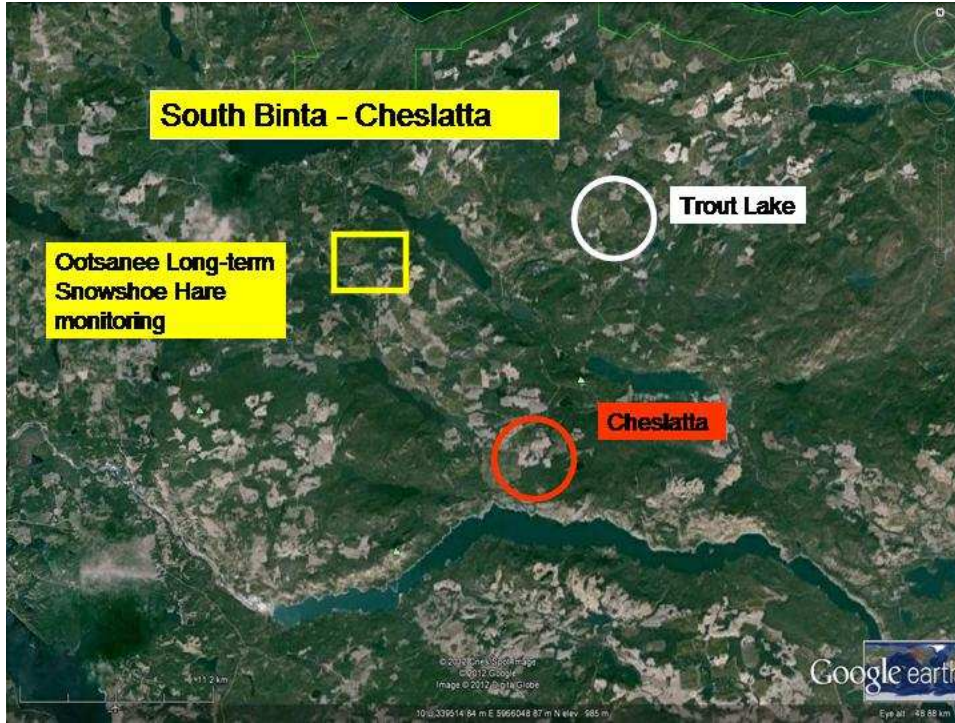


Table 1. Duck Lake Block assessment of hare –small mammal density and site specific attributes as they relate to the abundance of hares and small mammal densities.

Block Number	Date	Est. Burn Damage	Est. Stand Age	Hare Sign	Vole-Mouse Sign	Canopy Closure (%)	Ground Vegetation	Mineral Soils Visible	Vegetation Cover (%)
61958	10/20/2012	10		None	None	1	Grass	Yes	20
513450000	10/20/2012	80	40	None	None	10	Herb/shrub	Yes	10
514340000	10/20/2012	95	60	None	None	10	Herb/shrub	Yes	5
513330000	10/20/2012	20	40	Low	None	80	Herb/shrub	No	10
513310000	10/20/2012	20	40	Low-Mod	None	80	Herb/shrub	No	10
513360000	10/20/2012	80	45	High	None	80	Herb/shrub	No	10
513280000	10/20/2012	80	45	High	None	80	Herb/shrub	No	10
513940000	10/20/2012	70	30	High	None	70	Herb/shrub	No	90
514240000	10/20/2012	90	30	High	Mod	90	Herb/shrub	No	90
87593	10/20/2012	0-80	10	Low	High	80	Herb/Grass	No	100
513200000	10/20/2012	10	45	Mod	None	80	Herb/shrub	No	10
513340000	10/20/2012	10	35	Mod	Low	30-80	Herb/Grass	No	30
513060000	10/20/2012	10	35	Mod	Low	30-80	Herb/Grass	No	30
513370000	10/20/2012	10	35	Mod	Low	30-80	Herb/Grass	No	30
513070000	10/20/2012	10	35	Mod	Low	30-80	Herb/Grass	No	30
514380000	10/20/2012	20	12	None	Mod	25	Herb/shrub	Yes	50

At the two sites south of Binta Lake (Trout Lake and Cheslatta), (Map 5, Table 2), high snowshoe hare densities were associated with Cheslatta, and no hares sign was observed at Trout Lake.

Map 5. Trout Lake and Cheslatta, site specific seedling-snowshoe hare browse risk assessment



As with the Duck Lake sites, high hare densities were again associated with high suitability hare habitat in ~30 year old patches none-light burned patches, with high canopy closure. Here we also observed hare sign in the adjacent burned areas up to 100m from none burned areas.

Table 2. Trout Lake and Cheslatta Block assessment of hare – small mammal density and site attributes as they relate to the abundance of hares and small mammal densities.

Block Number	Location	Date	Zone	UTM E	UTM N	Est. Burn Damage	Est. Stand Age	Stand Height (m)	Hare Sign	Vole-Mouse Sign	Canopy Closure (%)	Ground Vegetation	Mineral Soils Visible	% Vegetation Cover
R13373 -1	Trout Lake	10/7/2012	10	347531	5972442	100	50	7	None	None	8	Herb/shrub/grasses	No	90
R13373 -1	Trout Lake	10/7/2012	10	347312	5972268	100	50	6	None	None	2	Herb/shrub/grasses	Yes	25
93F074-047 (801)	Cheslatta	10/7/2012	10	341559	5961919	50	30	5	High	None	Patchy	Herb/shrub/grasses	Patchy	55
93F074-047 (801)	Cheslatta	10/7/2012	10	343685	5961873	50	30	5	Mod	None	Patchy	Herb/shrub/grasses	Patchy	80

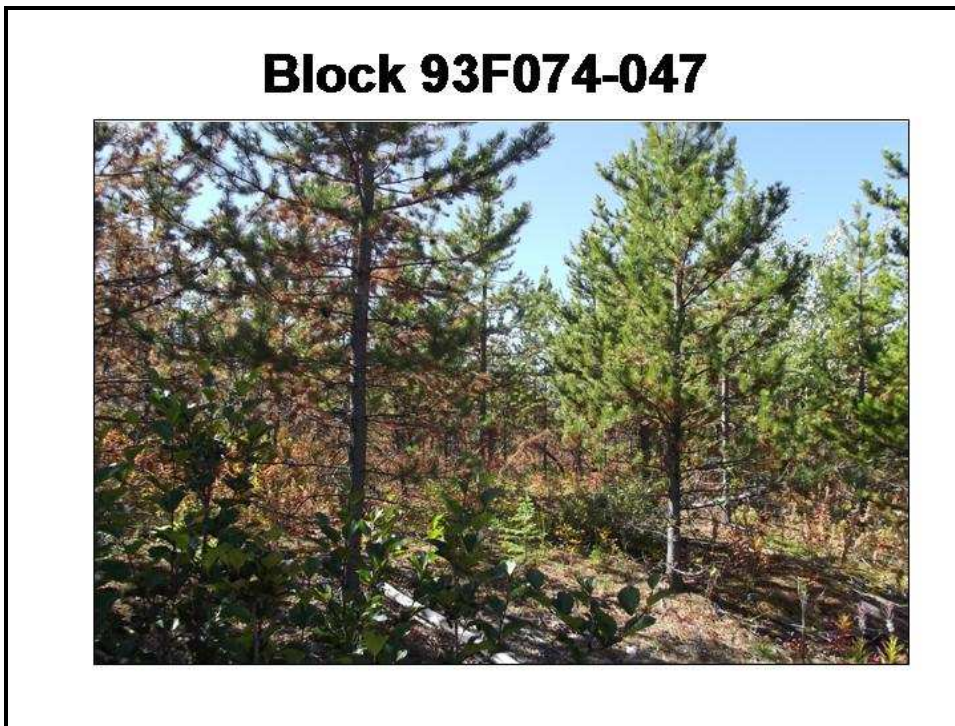
Sites with high hare density were typical of high suitability habitats with stands ranging from 35-45 years of age, and high canopy closure (light or no burn patches) (Picture 1),

moderate densities were found in more open sites (Picture 2), and lower densities were associated with open younger or severely burned areas (Picture 3a & b).

Picture 1. High suitability Snowshoe hare Habitat



Picture 2. Site with moderate snowshoe hare densities



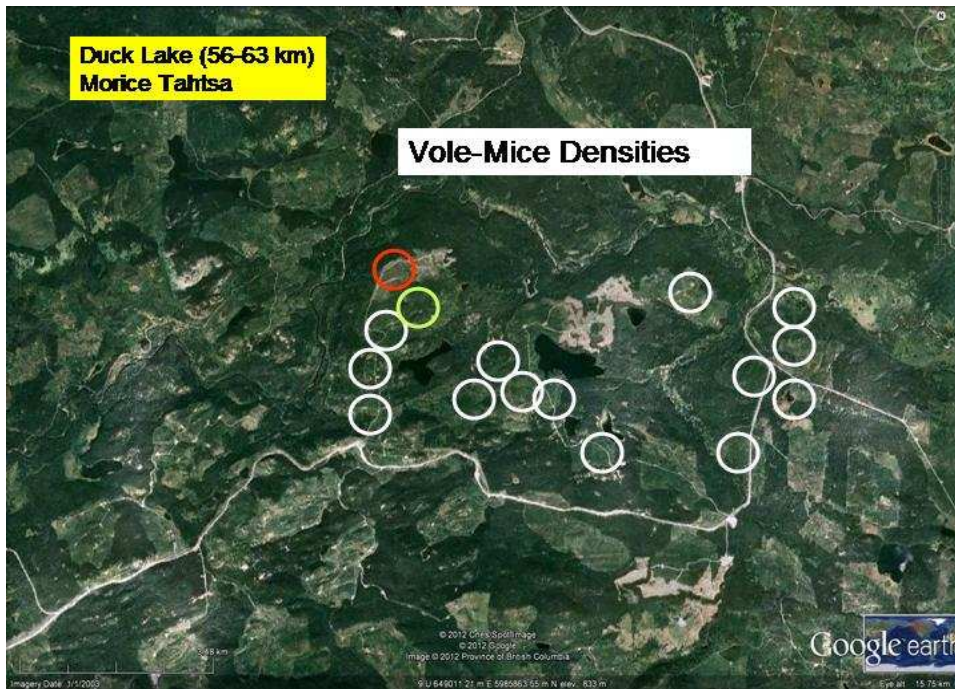
Picture 3a & b. Low suitability open-burned hare and small mammal habitats.



Focal Seedling-Small Mammal Browse Risk Assessment.

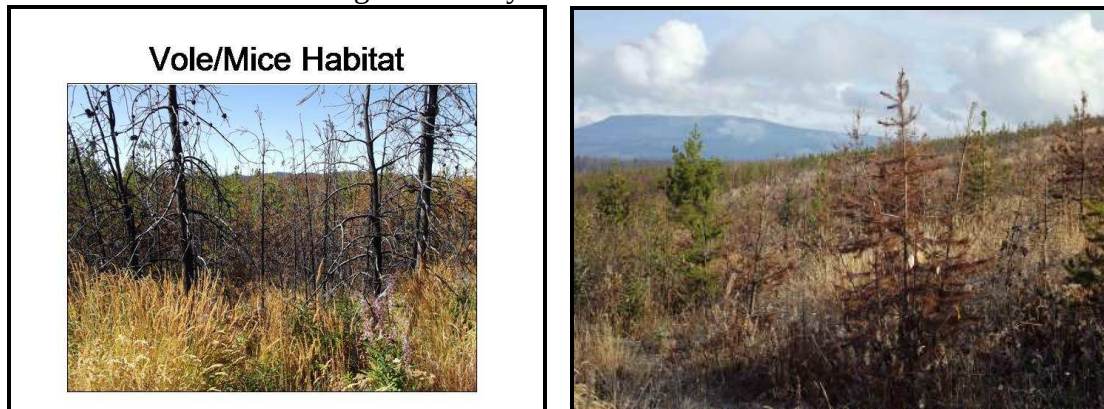
At Duck Lake, high small mammal sign was observed at one site, and moderate sign at 2 sites (Table 1, Map 6). The high site was characterized by a thick grass-herb layer in a younger open stand, and moderate sign was seen in an adjacent older second growth site, and in a younger open site with high grass cover. At Trout Lake and Cheslatta (Table 2), no small mammal sign was observed at either site.

Map 4. Duck Lake area site specific small mammal-sign observations (Circles: Red = high density, Green = moderate, White = low-nil).



However, in all sites (Duck Lake, Trout Lake and Cheslatta) there is the potential for high numbers of small mammals (and therefore risk of browsing to seedling trees) in all areas with high vegetation cover that included grasses. This is applicable to 5 of the 17 sites at Duck Lake and to both the Trout Lake and Cheslatta sites (Picture 5a & b). In many of the other sites a severe burn, down to visible mineral soils, has resulted in sparse vegetation cover, and low small mammal and snowshoe hare habitat suitability (Picture 3a & b).

Picture 5a & b. Potential high suitability vole-mice habitat



Discussion

Short-Term: Risk to Tree Seedlings Planted Post Fire

In all areas, the long-term monitoring of snowshoe abundance (based on fecal hare pellet counts), indicates that the numbers of snowshoe hares is increasing in many areas. With this backdrop and the known damage-loss of seedlings (particularly spruce) through browsing by snowshoe hares (Doyle 2008b), then any area with high to moderate observed densities may until hare populations decline, expect to see heavy losses-damage of newly planted seedlings,

Small mammal populations are known to respond to wildfires, with increasing densities in the years post fire (Amacher et. al. 2008, Sullivan 2012 (accessed), Zwolak 2008), and therefore there is the potential for an increase in seedling damage and losses as a result of small mammal browsing (Sullivan 2012). In addition, meadow voles are associated with grass-herb habitat (Morris 1984) typical of many of our sites post fire, and under favorable conditions this species can also cause considerable damage to seedling trees (Kennedy et. al. 1989).

From a silvicultural perspective this work shows that there is a risk that any site that needs to be replanted post fire, may at the time of planting next year (3 years post fire), be at risk of seedling losses-damage from both small mammals and snowshoe hares. Work on snowshoe hare habitat suitability in this region has provided guidance as to conditions that are favorable to the hares (Appendix 2), and this can be used as a management guide as to areas where planting can potentially occur with a lower risk of

seedling losses. However, the survey of the 17 sites in the Duck Lake area highlights how variable conditions may be depending on the severity of the fire, site type, site adjacency to hare-small mammal source habitats, patch size, etc, and therefore only a field check prior to planting can give an accurate assessment of the potential risk in individual blocks.

From a snowshoe hare cycle perspective in some moderate-high suitability hare habitats, underplanting in lightly burned, or patchy burned second growth stands, may be expected to see heavy losses (through browsing) of newly planted seedling. The silvicultural options to successful planting now may be limited, with the added expense and generally poor, or inconsistent results from anti herbivory products (Danskin 2007), and the expense (installation, maintenance and removal) of tree shelters (Hanna and Doyle 2008). As an alternative brushing and understory removal prior to planting may be expected to open up the habitat such that it is no longer suitable for hares, but again there is a tradeoff with the value of any surviving seedlings, and with the added expense of this work. In this scenario, it is possible that through continued monitoring, we can identify the natural decline in hare populations through the hare cycle dynamics, those seedlings can be ordered a year or so prior to the low in hare numbers, and then planted at the low of the hare cycle. On less vegetated sites this may allow seedlings to become established prior to the next increase in numbers in 5-6 years time. Unfortunately, on well vegetated site this option may be compromised by herb-shrub cover that does not allow the seedlings to grow.

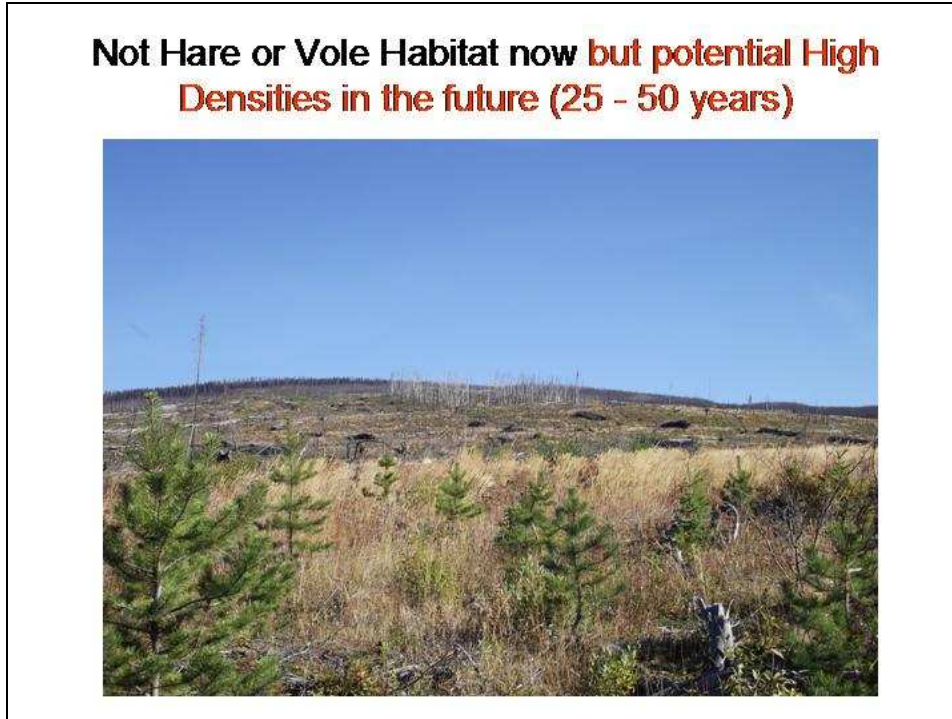
Long-Term: Managing for Seedling Trees in a Changing Landscape

From an ecosystem perspective the forested landscape that we were working with, planting and harvesting, has changed dramatically over the past 40 years. A landscape once dominated by late seral-mature forests, which was harvested in a patch system that allowed for a wide range of seral stages, is no longer the case. With the onset of the Mountain Pine Beetle, fires (possibly climate change related) and the commercial demand for specific tree types, the patchwork is now dominated by young seral forests <45 years, and much of this is even younger as we salvaged the MPB killed trees over the past 10 years.

As a result of these impacts and changes, our landscape in many areas is now dominated by young seral even aged forest, with smaller patches of mature and riparian forest, and areas of MPB killed pine and burned young seral and mature stands (Picture 6). These burned and MPB killed stands are now also supporting a vigorous shrub-herb and grass understory similar in composition to those seen in recently harvested areas.

From an ecological perspective these factors combined, have created large areas of high suitability snowshoe hare and possibly vole/mouse habitat (Morris 1984). Consequently we may see a far higher density of hares per hectare (Doyle 2008a), than we have seen at the peak in numbers during the last 4 hare cycles (hare numbers peak typically every 10 years). In this scenario we may expect to see far higher rates of seedling browse damage and loss when planting adjacent to, and within areas supporting high densities of hares.

Picture 6. Landscape area near Knapp Lake dominated by young seral stands.



In the future therefore, planting may have to be timed around the hare cycle to limit the losses of seedling trees, or to limit the expense that may be incurred protecting the seedling trees from browsing.

Literature Cited

Amacher, A.J., R. H. Barrett, J. J. Moghaddas and S. L. Stephens. 2008. Preliminary effects of fire and mechanical fuel treatments on the abundance of small mammals in the mixed conifer forest of the Sierra Nevada. *Forest Ecol. and Manag.* 255: 3193-3202

Danskin, D. 2007. Plant Skydd Application in underplanted MPB-killed pine stands: A brief summary. For Forest For Tomorrow Meeting. PG Fall 2007.

Doyle, F. I. 2008a. Snowshoe Hare Population trends in central-northwest British Columbia. Ministry of Forests and Range, Forest Practices Branch Victoria, BC

Doyle, F. I. 2008b. Annual Report. Mitigating the impacts of Snowshoe Hare browse damage on underplanted seedling trees in *Dothistroma* infested pine stands. MOFR Kalum and Skeena-Stikine Forest District.. *Dothistroma* Steering Committee, 2007

Doyle, F. I. 2011. Snowshoe Hare Population trend within Harvested Landscapes in Central-Northwest British Columbia. Forest Lands and Natural Resource Operations, Under direction of the *Dothistroma* Steering Committee.

Hanna, P. and F. I. Doyle. 2008. Silviculture Sx Trial. Installation Report. March 2008. MoFR. Kalum Forest District and Skeena-Stikine Forest District.

Kennedy, A. J., D. F. Penner, and J. E. Green. 1989. Small Rodent Populations and Conifer Seedling Damage on a Reclaimed Area in West Central Alberta. The Forestry Chronicle. 65(4):271-275.

Morris, D. W. 1984. Microhabitat separation and coexistence of two temperate-zone rodents. Canadian Field-Naturalist, 98(2):215-218.

Sullivan, T. P., D. S. Sullivan, and P. M. F. Lindgren. 2000. Small mammals and stand structure in young pine, seed-tree, and old-growth forest, southwest Canada. Ecol. Applic. 10:1367-1383.

Sullivan, T. P. Voles, Hares and Protection of Forest Plantations. (Accessed December 2012). Department of Forest Sciences, Faculty of Forestry. University of BC <http://www.appliedmammal.com/content/brochures/VoleBrochure-FINAL.pdf>

Zwolak, R., and K. R. Foresman. 2008. Deer mouse demography in burned and unburned forest: no evidence for source-sink dynamics. Canadian Journal of Zoology 86:83-91.

Appendices

Appendix 1. Snowshoe Hare Pellet Counts

Location	Date	Zone	UTME	UTMN	Transect #	Pellet Quardant #	Quadrant (10X300 cm)			Quadrant (10-30X300 cm)			Total
							Adult	Juvenile	Sub Total	Adult	Juvenile	Sub Total	
Trout Lake	10/7/2012	10	347531	5972442	N/A	No Sign - No Quadrants							
Trout Lake	10/7/2012	10	347312	5972268	N/A	No Sign - No Quadrants							
Cheslatta	10/7/2012	10	341559	5961919	1	1	4	16	20	11	8	19	39
Cheslatta	10/7/2012	10	341557	5961956	1	2	2	2	4	8	0	8	12
Cheslatta	10/7/2012	10	341547	5961992	1	3	2	3	5	7	2	9	14
Cheslatta	10/7/2012	10	341576	5962019	1	4	3	3	6	7	5	12	18
Cheslatta	10/7/2012	10	341563	5962030	1	5	6	5	11	12	6	18	29
Cheslatta	10/7/2012	10	341536	5961955	1	6	8	3	11	3	2	5	16
Cheslatta	10/7/2012	10	341540	5961924	1	7	2	0	2	8	3	11	13
Cheslatta	10/7/2012	10	341531	5961868	1	8	2	0	2	5	1	6	8
Cheslatta	10/7/2012	10	341455	5961855	1	9	7	3	10	4	2	6	16
Cheslatta	10/7/2012	10	341504	5961880	1	10	2	3	5	10	10	20	25
Cheslatta	10/7/2012	10	341684	5962121	2	1	6	0	6	4	0	4	10
Cheslatta	10/7/2012	10	341706	5962119	2	2	0	0	0	1	0	1	1
Cheslatta	10/7/2012	10	341709	5962145	2	3	4	0	4	7	0	7	11
Cheslatta	10/7/2012	10	341705	5962194	2	4	0	0	0	0	0	0	0
Cheslatta	10/7/2012	10	341737	5962231	2	5	1	0	1	2	0	2	3
Cheslatta	10/7/2012	10	341759	5962257	2	6	0	0	0	1	0	1	1
Cheslatta	10/7/2012	10	341759	5962294	2	7	3	0	3	2	0	2	5
Cheslatta	10/7/2012	10	341762	5962317	2	8	7	0	7	18	0	18	25
Cheslatta	10/7/2012	10	341758	5962346	2	9	3	0	3	5	0	5	8
Cheslatta	10/7/2012	10	341735	5962376	2	10	0	0	0	0	0	0	0

Appendix 2. Seedling Risk Assessment



Factors impacting the Risk of Damage-Mortality to unprotected Seedlings by Snowshoe Hares in north-central BC

	Influential Factors	Low Risk	High Risk
Tree Species	Palatability	Subalpine Fir, Hemlock	Spruce, Pine, Cedar
Stocking Density	# Seedlings planted	High stocking density (1.5 X 1.5 m spacing)	Standard stocking density
Hare Density	Hare Cycle	2 years after Peak	All other Years
Site Conditions	% Ground Cover	<30% Ground Cover (>0.5m High)	>30% Ground Cover (>0.5m High)
Fire History	Time Since Fire	Recent <=1 year	>= 3 years
	Site Treatment	Suppression of Cover (brushing-herbicide, etc.)	None
Harvest History	Time Since Harvest	Recent <=1 year	>= 3 years
Silvicultural Treatment	Site Treatment	Suppression of Cover (brushing/ thinning-herbicide, etc.)	None
Snow Depth	Stand cover in winter	Snow will typically cover seedlings early in fall	Snow will <u>NOT</u> typically cover seedlings early in fall
Adjacent Stands	Hare carrying capacity	Low density of hares	High density of hares