UNCHA MOUNTAIN RED HILLS: VEGETATION MANAGEMENT IN A POST-MOUNTAIN PINE BEETLE LANDSCAPE

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Summary

Uncha Mountain Red Hills Park contains a diverse mix of vegetation, including grasslands, a variety of forest types, rock outcrops and wetlands. The vegetation has been undergoing changes, and park managers are interested in finding out if management actions are needed to manage the vegetation in response to these changes. The objective of this project is:

- to provide direction to the Ministry of Environment, Environmental Stewardship Division on managing the vegetation of Uncha Mountain Red Hills Park in a post-mountain pine beetle landscape.

Three main changes were of concern are affecting three different vegetation types, they are:

1. pine trees are being killed by mountain pine beetle,
2. grasslands have been changing and being encroached by woody species mainly aspen, and
3. rare Douglas-fir stands, that historically were very open, may be being in-filled by young trees.

These changes must be seen in the context of vegetation succession from past fires and natural processes occurring.

Natural values in Uncha Mountain Red Hills Park are very high in terms of vegetation and wildlife. The forests are mostly made up by mixed species stands containing in varying mixtures lodgepole pine, interior spruce, subalpine fir, trembling aspen, Douglas-fir, paper birch, with minor amounts of cottonwood and black spruce. Grasslands presently cover 129 ha of the park, with most grasslands located on steep rocky south-facing slopes above François and Uncha lakes. These grasslands are Red-listed by the BC Conservation Data Centre. Several other plant communities at risk occur in the park, most significantly a Blue-listed Douglas-fir forest type near the northwestern edge of the range of Douglas-fir. The most significant wildlife values in the park are very high and high quality moose and deer winter range habitat.

Management direction for the park, given in the Lakes Land and Resources Management Plan and in the park Management Direction Statement, is clear that management actions to maintain plant communities at risk and in response to mountain pine beetle are acceptable. Potential impacts to values adjacent to the park must also be considered when managing the park. Provincial park policy indicates that natural processes will be allowed to proceed as much as possible, but that management actions, such as prescribed fire, are acceptable in certain circumstances.

This report looked at the need for management action to related to the three types of changes occurring in the park.

1. The mixed species forests in the park limits the impact of mountain pine beetle in the park, both in terms of effects on wildlife and wildlife habitat, and increased fire risk. While there are impacts to wildlife through a number of factors as the changes to the forests from mountain pine beetle occur, the changes will also benefit some species.

   The current fuel characteristics of the stands within the park are similar to areas surrounding around the park and are not more hazardous than stands in the surrounding areas. Likewise, the fire behaviour potential of stands within the park is not greater than that in the surrounding areas. Adjacent areas with the most hazardous fuel types are located southeast of the Uncha Mountain portion of the park and at the crest of the Red Hills. The most heavily developed areas adjacent to the park, west of Uncha Mountain and west of the Red Hills, are dominated by fuels with lower

fire behaviour potential, or a mix of fuel types. The potential for fire to spread from the park to populated areas is not high due to the less hazardous fuel types in these areas.

After mountain pine beetle, the fuel types in the park will change over time. In the red attack stage there is an increase in fire risk due to the low moisture content of the dead pine needles, both on the trees and after they fall. The risk of crown fire will decrease as needles fall and the risk of ground fire will decrease as needles decompose. As dead trees fall the surface loading of fuels will increase, but knowledge of fire behaviour dynamics in stands with these fuel characteristics is lacking and further research is required.

As live pine trees are killed by mountain pine beetle, the fire risk will increase in those stands where the more hazardous conifer species such as spruce and subalpine fir become dominant, but decrease in stands where aspen becomes more dominant. Over time, as dead stems fall down and coarse fuels build up, the risk of fire will increase.

Values of the fire weather index system components are relatively low for the Uncha Mountain Red Hills Park area throughout the fire season. The fuel types with the highest fire behaviour ratings may support crown fires, but the number of days in which conditions would allow a crown fire to carry are relatively few.

It is recommended that natural processes be allowed to proceed in regards to mountain pine beetle, because:

i. the generally mixed species forests in the park provide resilience against the effects of mountain pine beetle,

ii. the effects of mountain pine beetle to wildlife and wildlife habitat will benefit some species and impact others; the overall impact does not warrant the use of prescribed fire, and

iii. the risk of wildfire from the park to values outside the park is not great enough to warrant intervention at this time.

2. The grasslands in the park are mostly Saskatoon – Slender wheatgrass scrub/steppe (SBSdk/81), though other grassland types may also be present. A total of 129 ha of grasslands have been mapped, distributed among all three parcels that make up the park. The extent of grassland has decreased over time as seen on the airphotos taken in 1949, 1971 and 2005; the driest areas appear to have remained grassland.

Three management options are available: let natural processes proceed, maintain the existing grasslands, and expand grasslands to former extent. It is recommended that:

- the goal be, at a minimum, to maintain the existing grasslands. In some instances, grassland expansion through restoration may be a suitable goal. Linking with a similar project being pursued by the Bulkley Valley Centre for Natural Resource Research and Management are recommended to undertake these goals.

Two tools are available, which can be used alone or in combination: prescribed burning and manual tree girding/removal. To maintain the existing grasslands, the following restoration efforts are recommended.

i. Visit all mapped grassland to determine which are in greatest need of restoration, where restoration is most likely to succeed, and where reference plots should be located.

ii. Establish monitoring and reference plots before conducting any on ground activity. These plots will record the current vegetation composition and wildlife activity through fecal pellet counts following methods in Veenstra and McLennan (2002) and RISC (1998).
iii. Assess the area to determine if a burn will be feasible given fuels on the site.
iv. If a burn is feasible, initiate planning for and complete a prescribed burn using expertise from the Northwest Fire Centre and Nadina Forest District. Planning will need to consider:
    a) timing a spring burn before plants leaf out is best to limit the potential of ground fire escape; however, there is a higher risk of crown fire in the spring if grass fire is allowed to get into the crowns, due to the low for foliar moisture content in the spring; problems may occur at top of a slope where there is a transition from grass slope to conifers.
    b) the potential for fire to escape the target area. Burning some area covered in shrubs or aspen would be desirable, but a crown fire would be undesirable.
    c) impact to non-target vegetation. There is Rocky Mountain juniper in the area that should be protected. Fuels may need to be raked from the base of these trees.
v. If a burn is not feasible, fuels may be increased by manually girdling or hinging aspen and conifers that may be in or on the edge of the grassland. This may increase the light availability, plant growth and eventually increase fuel loading to allow a burn in the future.
vi. Remeasure monitoring plots in the year following management activities and analyse data.
vii. Reburn any burnt areas to continue control of woody vegetation. It may take a number of years before there are enough fuels to carry another fire, but repeat burns are needed to control woody vegetation.

The risks in this prescription are:

i. the potential for facilitating weed invasion or expansion; this is addressed in Section 6.6,
ii. the potential that woody species will not be controlled; adaptive management through working with similar projects will allow learning to occur,
iii. the potential for fire escape,
iv. excessive smoke bothering local residents; burning in the right weather window will prevent this, and
v. lack of funding preventing project from continuing until completion.

3. The rare Douglas-fir stands occur in the Red Hills portion of the park, though Douglas-fir also occurs in the Uncha Mountain portion. These stands provide important wildlife habitat, both as live trees and as standing and fallen dead trees. They can provide critical ungulate winter range, especially for deer, in heavy snow years. The density of trees in these rare stands has been increasing over the last 60 years, through regenerating Douglas-fir and other tree species. This could diminish the habitat value of these stands.

   It is recommended that natural processes be allowed to proceed in the Douglas-fir stands, but that further investigations of stand dynamics and stand structure be undertaken. This is because:

   i. Douglas-fir stands provide important wildlife habitat, especially for ungulates in winter in terms of shelter and forage,
   ii. there is a risk of a crown fire because of the development of ladder fuels from the conifer regeneration, and
   iii. there is little knowledge of Douglas-fir stand dynamics in this part of its range.

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1 Introduction

All components of ecosystems are dynamic and respond to changes in environmental conditions. These conditions can include any element of the biotic and abiotic environment such as soil or air temperature and moisture, predator densities, insect outbreaks, and seed sources. Different species or ecosystems may respond differently to specific changes. Also, human perception of ecosystem dynamics must be examined carefully since our period of observation may be shorter than the cycle of natural variation for that ecosystem. For example, in Colorado perceptions of aspen[1] decline due to fire suppression were shown to be incorrect when a longer time span was used for analysis (Kulakowski *et al.* 2006).

Uncha Mountain Red Hills Park contains a wide range of plant communities, some of which are at risk; changes in environmental conditions have resulted in varied responses by these communities. Some changes in environmental conditions result directly from human activities, while others result from large-scale processes that humans may have contributed to indirectly. Changes in environmental conditions include: introduction of cattle grazing; reduction in fire frequency through fire suppression and elimination of First Nations burning; the current mountain pine beetle (MPB) epidemic; forest harvesting; introduction of exotic plant and animal species; and climatic change (affecting temperature, precipitation and soil moisture).

The most significant issues in Uncha Mountain Red Hills Park resulting from environmental changes are:

- effects of mountain pine beetle-killed stands on park values,
- encroachment of trees onto rare grasslands, and
- infilling of rare open Douglas-fir stands.

The MPB epidemic in British Columbia is having widespread effects on many species and ecological communities, and on ecosystem function. The scale of the epidemic is unprecedented in the province yet much still needs to be learned about its impact. A major concern in areas affected by MPB is the potential for large-scale forest fires due to a large number of dead trees on the landscape. In protected areas, effects on wildlife and recreational infrastructure, and cultural values must also be considered.

In grasslands in the area covered by this report, encroachment by aspen is the main concern. Encroachment, defined as the establishment of a significant number of trees in grassland areas that were not previously forested, has been facilitated by the lack of fire in the area for many years. This process is a threat to the maintenance of the grasslands and the species that depend upon them.

Open Douglas-fir stands in the area may be under threat from in-growth. In-growth refers to the process of dense stands of trees establishing in open forests or treed grasslands. In-growth can reduce the value of open forests for wildlife species.

With the environmental changes described above, the Ministry of Environment, Environmental Stewardship Division is exploring the need for vegetation management in Uncha Mountain Red Hills Park. Information on the impacts of these environmental changes, and required management actions is needed by managers in order for the ministry to fulfill its mandate to maintain the diversity of ecosystems, fish and wildlife species, and their habitat in the province.

[1] Latin names for all species used in the text are given in Appendix 1.

1.1 Project Objectives

The objective of this project is:

- to provide direction to the Ministry of Environment, Environmental Stewardship Division on managing the vegetation of Uncha Mountain Red Hills Park in a post-mountain pine beetle landscape.

In addition to managing the effects of the MPB epidemic, other ecological processes occurring in the park, including successional processes on grasslands, need to be addressed.

Key considerations for management direction in Uncha Mountain Red Hills Park include:

- fuel loading and the potential for fire,
- conservation of rare plant communities,
- quality of wildlife habitat, especially ungulate winter range,
- cultural values,
- values external to the park,
- fish habitat values, and
- range values.

Management direction in this report is presented in three sections:

- Section 5 – Managing Forests and Mountain Pine Beetles,
- Section 6 – Managing Grasslands, and
- Section 7 – Managing Rare Forested Plant Communities.

Although the grasslands in the park often contain a pine component that may be affected by MPB, grasslands are presented in a separate section because the MPB epidemic is not the dominant process occurring in these communities. Similarly, some of the rare forest communities are not pine dominated and have different management concerns and methods than grasslands; they are also treated in a separate section.

1.2 What is Restoration?

Restoration is defined as "the process of assisting the recovery of an ecosystem that has been degraded, damaged or destroyed" (Society for Ecological Restoration International 2004). The word restoration is often used in conjunction with forests that have been attacked by MPB. Burton (2006) questions whether these forests are degraded, damaged or destroyed. An assessment of any planned intervention must consider whether management activities will do more good than harm, and must be viewed against the alternative for no treatment (Burton 2006). One question that needs to be asked before proceeding is "what is the area being restored to?", which can be restated as "what is the end state or desired future condition I want for this ecosystem?".

If the ecosystem is not degraded, damaged or destroyed, restoration is not an appropriate term to describe management activities. However, two human activities are thought to have contributed to the current MPB epidemic. Fire fighting activities in the last 80 years have greatly reduced the area of forest burned in British Columbia. This has resulted in the percentage of the lodgepole pine forest area in age classes susceptible to MPB attack increasing from an estimated long-term average of 17-25% to an estimated 55% presently (Taylor *et al.* 2006). The proportion of the province with a climate suitable for MPB has also greatly increased over the last 40 years (Taylor *et al.* 2006). This climatic change has been at least partly attributed to increases in carbon dioxide and other gases in the atmosphere due to human activities (IPCC 2001).

Despite the influence of human activities on the MPB epidemic, restoration does not seem to be the appropriate term for management activities related to addressing the effects of MPB on protected area landscapes (Burton 2006). In protected areas, MPB is considered a natural part of forest dynamics and forest renewal (Gawalko 2004). However, vegetation management activities may be required in protected areas in a post-epidemic landscape (Gawalko 2004). For the lack a better word, we will call these potential management activities “restoration” for the purpose of this report. The term restoration may be more appropriately used for grassland ecosystems in the park, which have been impacted directly by cattle grazing and fire suppression.

1.3 Restoration Planning

Management activities designed to change vegetation composition in an area require a long-term outlook for the future of the ecosystem. The following key aspects need to be considered when planning restoration activities (Ministry of Water, Land and Air Protection 2002):

- restoration of internal processes,
- removal of degrading agents,
- identification of future desired condition, and
- monitoring of the outcomes of management activities.

The process that is most obviously missing from Uncha Mountain Red Hills Park is fire. In the absence of fire, succession has been a degrading agent to rare grasslands. Mountain pine beetle is not a degrading agent but a natural disturbance agent. Future desired condition for grasslands is “open grasslands that are free from dense stands of woody species and exotic species and that are subject to normal ecological processes”. Monitoring after management activities is critical to determine if the activities have been successful.

The scale of restoration may vary with the restoration project. The Ministry of Environment recognizes three scales for restoration activities (Ministry of Water, Land and Air Protection 2002):

- the ecosystem process scale,
- the habitat scale, and
- the species scale.

For grasslands, fire is the process that needs to be restored. If fire is restored to grasslands, restoration of habitat features (i.e. open grasslands and younger desired woody species like Saskatoon) may follow. No species-specific restoration is planned; however, fire may stimulate growth and/or re-establishment of native species from seed banks.

A long-term commitment is required before any restoration effort begins; a single year treatment will not be sufficient.

2 Study Area Description

Uncha Mountain Red Hills Park covers 9,421 hectares, and is located in central British Columbia approximately 20 km south of Burns Lake in the Bulkley Basin Ecosection. The park consists of 3 separate land parcels: the Red Hills (1,554 ha) on the north shore of François Lake 9 km east of the community of François Lake; Uncha Mountain (7,773 ha) between the south shore of François Lake and Uncha Lake to the south; and the Shannon Property (94 ha) on the north shore of François Lake 4 km east of the Red Hills parcel (Map 1).

The park contains a variety of terrain. Significant features include the warm south-facing slopes above François and Uncha lakes, Uncha Mountain, and the cool north-facing slopes above François Lake below Uncha Mountain and in areas east of Uncha Creek.

Five subzones of the Biogeoclimatic Ecosystem Classification (BEC) system are found within Uncha Mountain Red Hills Park (Table 1, Map 2). Early BEC mapping showed two BEC subzones in the park: Sub-Boreal Spruce dry cool (SBSdk) and Sub-Boreal Spruce moist cool, Babine variant (SBSmc2). A recent review of BEC boundaries has added three additional subzones: the Sub-Boreal Spruce dry warm, Stuart variant (SBSdw3), Engelmann Spruce Sub-alpine Fir moist cold (ESSFmc) and Engelmann Spruce Sub-alpine Fir moist very cold, Nechako variant (ESSFmv1). The majority (60%) of the park is within the SBSdk.

Table 1. Representation of Biogeoclimatic subzones within Uncha Mountain Red Hills Park

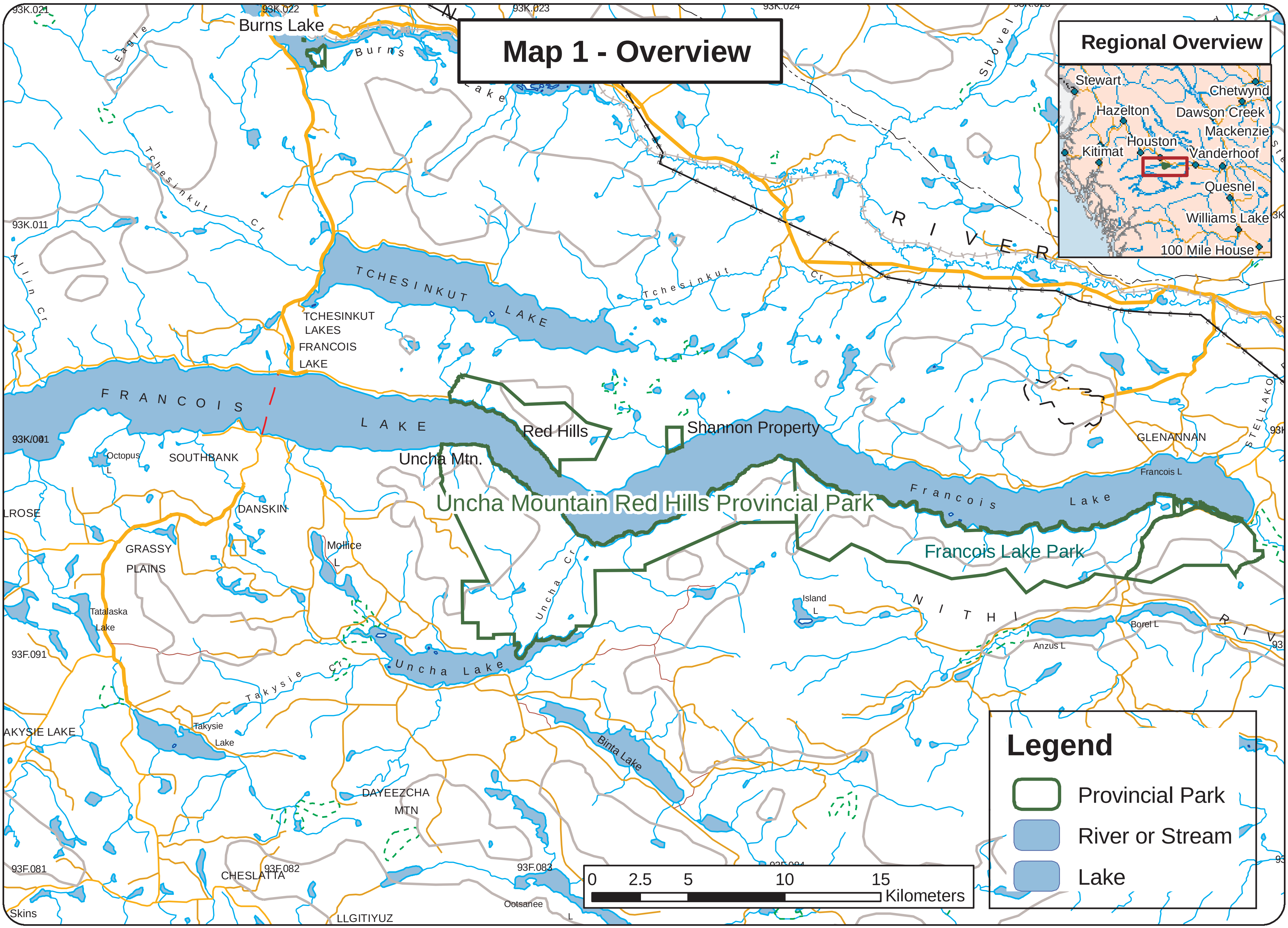
Subzone	Area (ha)	Location
ESSFmc	808	High elevation portion of Uncha Mountain, above approximately 1200 m elevation
ESSFmv1	123	Small area above approximately 1200 m elevation at extreme eastern end of Uncha Mountain portion of park.
SBSdk	5,676	Most of the Red Hills portion; and all areas below approximately 1000 m elevation near Uncha Mountain and Creek.
SBSdw3	1,685	Shannon Property; areas below approximately 1000 m elevation east of Uncha Creek; and extreme eastern portion of Red Hills portion
SBSmc2	1,129	Areas between approximately 1000 and 1200 m elevation on Uncha Mountain.

2.1 Natural Values

2.1.1 Vegetation

<u>Forest Composition</u>

The vegetation of the park is very diverse, reflecting the large number of BEC subzones, the range of habitats, and the fire disturbance history. Eight tree species are found on forest cover map labels for the park, with lodgepole pine, interior spruce and trembling aspen being dominant (Table 2, Map 3). Lodgepole pine is the dominant leading species, while interior spruce is the most common secondary species. Trembling aspen and interior spruce leading stands also form a major component of forests in the park. Of the pine-leading polygons, only 400 ha are pure pine. Overall, 71% of the forests in the park have a pine component; 35% of those forests contain <70% pine. Subalpine fir and paper birch are rarely leading species but are relatively common as secondary or minor species.



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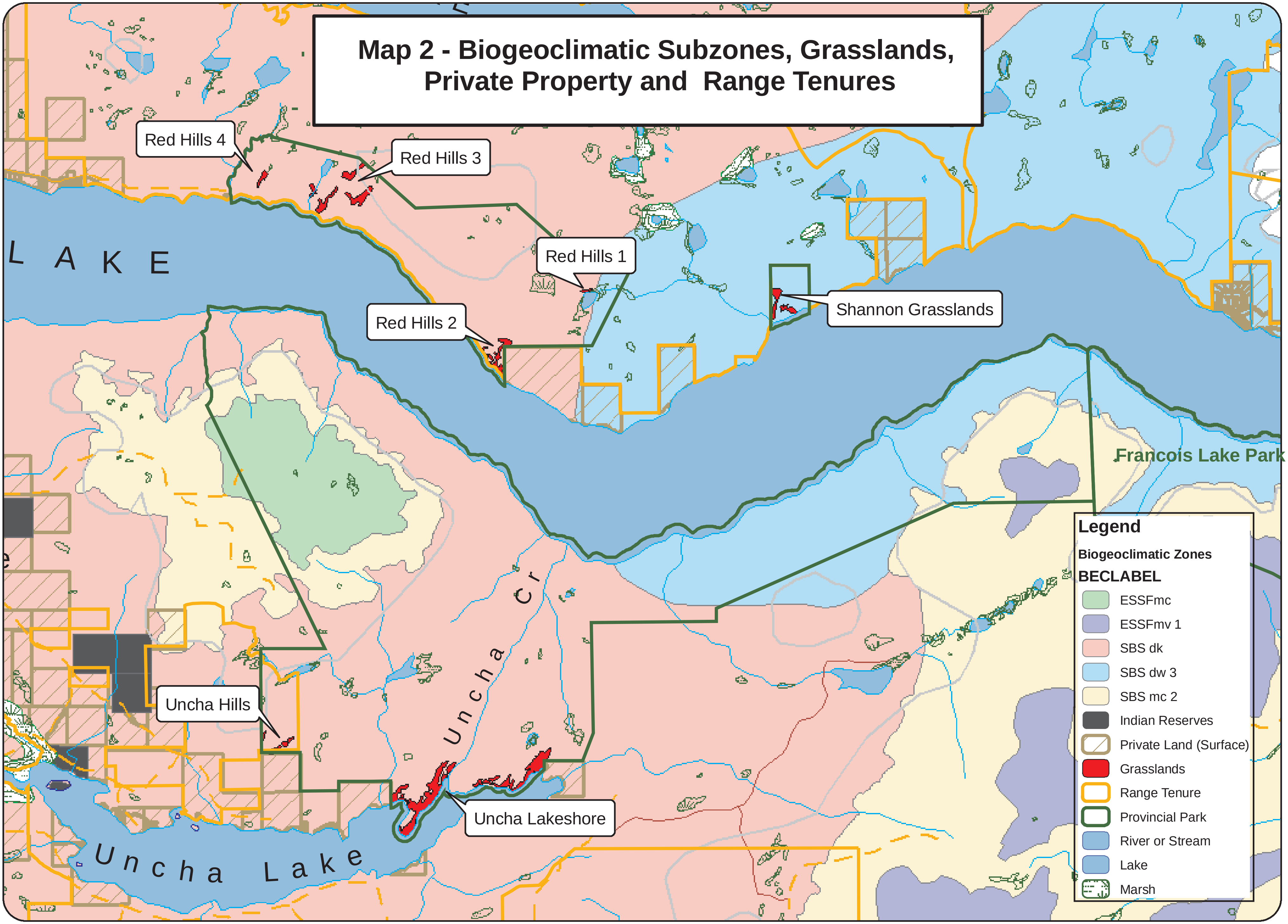
Map 2 - Biogeoclimatic Subzones, Grasslands, Private Property and Range Tenures



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1 centimeter equals 1 kilometer

Table 2. Tree species composition of the forests in Uncha Mountain Red Hills Park from forest cover maps

Tree species	Leading (ha)	Secondary (ha)	Minor (ha)	Total (ha)
Interior spruce	1,294	4,193	1,313	6,800
Lodgepole pine	4,396	1,190	1,097	6,683
Trembling aspen	2,248	632	1,613	4,493
Subalpine fir	61	790	579	1,430
Douglas-fir	530	103	50	683
Paper birch	0	192	281	473
Black cottonwood	19	78	0	97
Black spruce	35	0	0	35

Forest harvesting occurred in part of park during World War II, and in the late 1950's and early 1960's, mostly on the south shore of François Lake. Logging was done by hand, and used horses to pull the logs to the lake. Harvesting occurred to 400 m above François Lake. Some of the aspen stands in logged areas may have resulted from logging disturbance (B. Matthews *pers. comm*., local resident).

Age class distribution of the forests is fairly evenly among young forest, mature forest and old forest classes (Table 3). When age class is examined by leading species, there is also a fairly good representation of species in each age class (Table 4, Map 4). No stands < 40 years old are in the park, indicating the lack of recent disturbance.

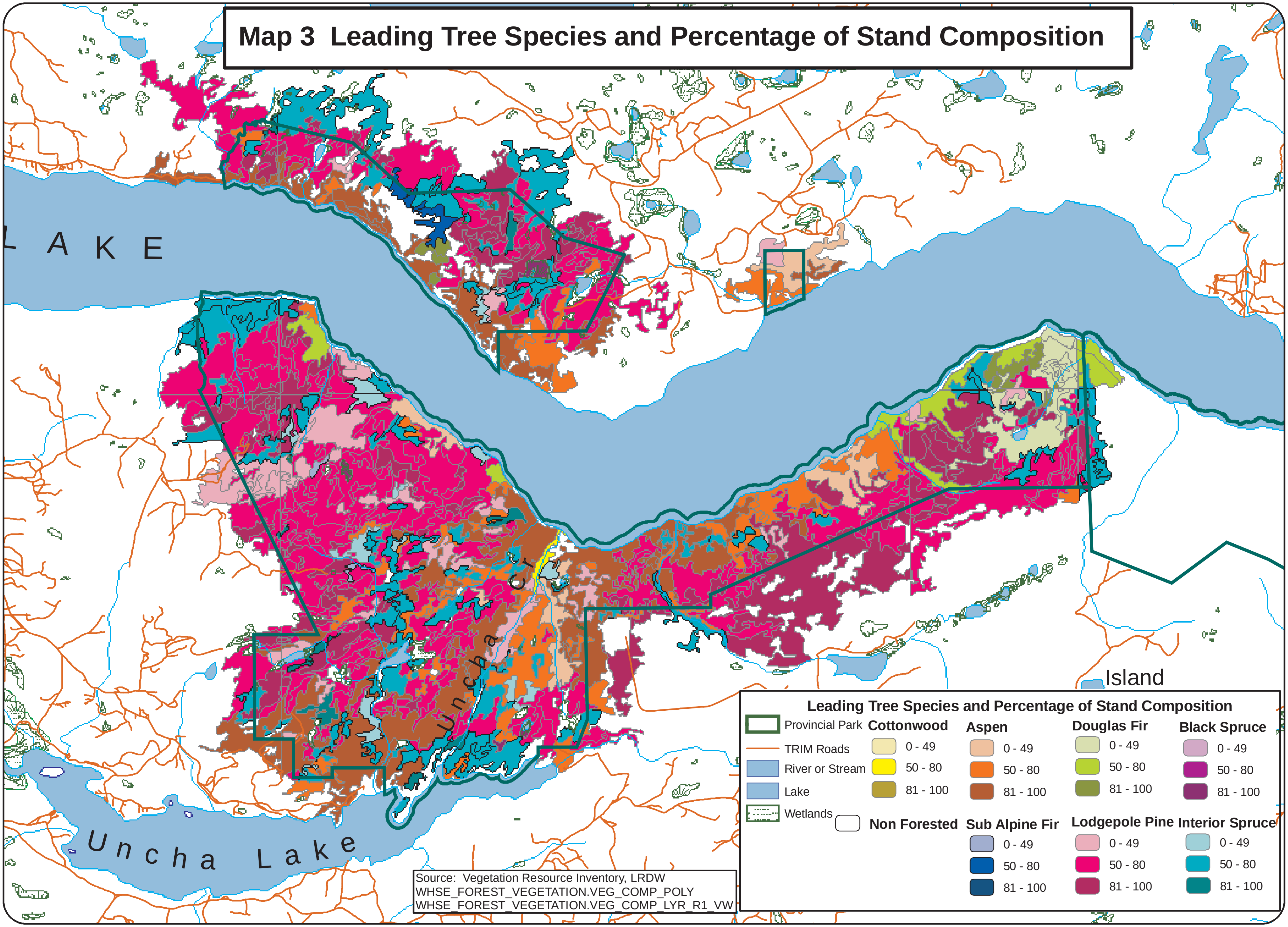
Table 3. Age class distribution of vegetation in Uncha Mountain Red Hills Park by section

Age Class[a]	Section (ha)			Entire Park	
	Uncha Mtn.	Red Hills	Shannon	ha	%
Non-forested	518	301	18	838	9
1 to 4 (<80 yrs)	1,884	450	41	2,374	25
5 (81-100 yrs)	1,791	371	0	2,162	23
6 (101-120 yrs)	459	94	0	553	6
7 (121-140 yrs)	1,039	48	36	1,123	12
8 & 9 (>141 yrs)	2,081	289	0	2,370	25
Totals	7,772	1,554	94	9,420	

a - based on structural stage classes, Young forest = <80 yrs, mature forest = 80-140 yrs, old forest = >140 yrs (Ministry of Environment and Ministry of Forests 1998).

Table 4. Age class distribution of vegetation in Uncha Mountain Red Hills Park by species

Age Class	Species (ha)						
	Pine	Aspen	Interior spruce	Douglas-fir	Subalpine fir	Black spruce	Cottonwood
<80 yrs	1,576	470	301	21	6	0	0
81-100	792	920	323	127	0	0	0
101-120	250	164	60	25	48	7	0
121-140	547	550	26	0	0	0	19
>141 yrs	1,231	145	584	357	7	28	0
Totals	4,396	2,248	1,294	530	61	35	19



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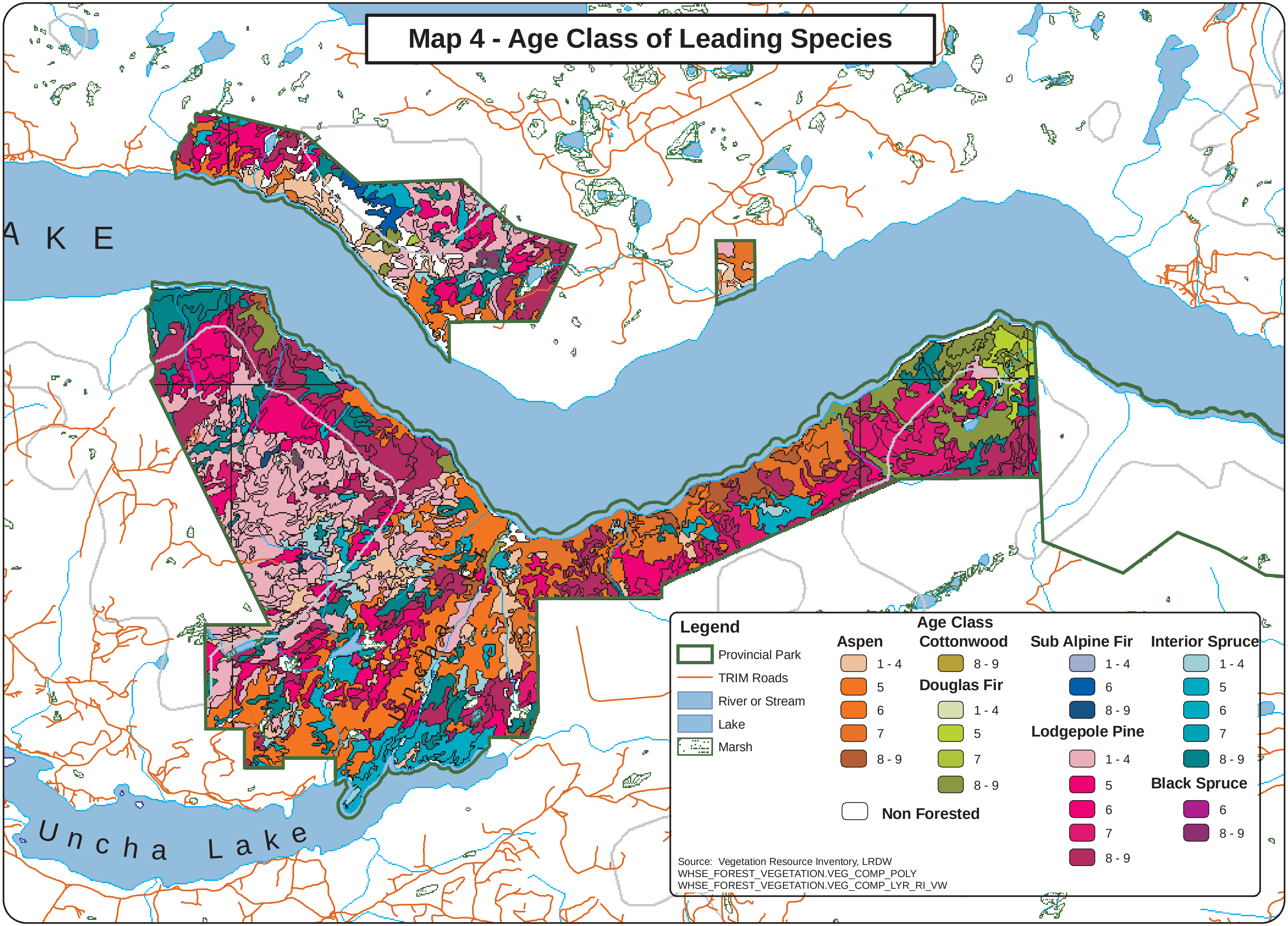
February 16, 2007

1 centimeter equals 1 kilometer

Map 4 - Age Class of Leading Species



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1 centimeter equals 1 kilometers

In Uncha Mountain Red Hills Park, the proportion of the park with older forests (100^+ yrs age class) is slightly less than observed proportion in the larger biogeoclimatic subzones, and similar to the historical proportion (Table 5) (Steventon 2002). The park contains more forests 40-100 years in age and fewer forests <40 years in age than either currently observed or historically present in the overall biogeoclimatic subzones. The proportion of forests in different age classes will vary over time depending on the disturbance rate, which can vary widely over time (Steventon 2002).

Table 5. Median percentiles for the proportions of biogeoclimatic subzones within age classes as observed in 1994 and historically[a]

Subzone	Simulated historic proportions (%) Age Class			Observed proportion (circa 1994)(%) Age Class		
	<40	40-100	100^+	<40	40-100	100^+
ESSFmc	18	17	64	6	18	76
SBSdk	39	25	32	15	30	54
SBSmc	28	22	48	21	17	61
Uncha Mountain Red Hills Park[b]				0	53	47

a - from Steventon (2002), numbers presented are the median of a range based on a Range of Natural Variation model

b - Uncha Mountain Red Hills Park data was not broken down by subzone.

The MPB susceptibility ratings indicate that 30% of the stands have a large enough pine component to warrant a susceptibility rating (Table 6). This is similar to the 29% in areas adjacent to the park, though areas adjacent to the park have a slightly greater percentage of area with extreme and high ratings.

Table 6. Mountain pine beetle susceptibility ratings for vegetation in Uncha Mountain Red Hills Park[a]

Susceptibility rating	Within park		Adjacent to park (<5 km away)	
	Area (ha)	%	Area (ha)	%
Extreme	666	7	3,615	9
High	734	8	3,946	10
Moderate	472	5	1,681	4
Low	910	10	2,373	6
No susceptibility	421	4	11,406	28
Not rated	6,124	65	18,157	44
Totals	9,327		41,180	

a - from Blackwell and Steele 2002

While MPB susceptibility ratings are informative, it is also important to examine the remaining live forest composition. Forest cover maps indicate that of the 6683 ha with a pine component only 404 ha were pure pine stands, with 1000 ha being >90% pine. Pine stands are most commonly mixed with interior spruce; subalpine fir and aspen are the second and third most common secondary species. Therefore, there will be a substantial component of live canopy trees in most stands following the MPB epidemic.

Grasslands and Other Vegetation Types

The Grassland Conservation Council of BC (2004) mapped 129 ha of grassland in Uncha Mountain Red Hills Park by the methods used by described in Section 6.1 (Table 7). Most of these grasslands occur on steep rocky terrain and would be classified as SBSdk/81 (Saskatoon – Slender wheatgrass scrub steppe) (Figure 1). Uncha Mountain Red Hills Park has little grassland area that might be classified as SBSdk/82 (Bluegrass – Slender wheatgrass), but there may be some on the Shannon Property and at the eastern end of Red Hills where the terrain is more gentle(Figure 2).

Table 7. Grassland mapping in statistics for Uncha Mountain Red Hills Park[a]

Location	Total Area (ha)	Grassland Area (ha)	# Polygons	% of total area
Red Hills	1,554	37	7	2.4
Uncha Mountain	7,773	82	6	1.1
Shannon Property	94	10	2	10.8
Total	9,421	129	15	1.4

a - from Grassland Conservation Council 2004

All of the grasslands in the park have a history of cattle grazing. The only active grazing occurs in the Red Hills, which entirely covered by a Grazing Licence, and the southwest corner of the Uncha Mountain portion, which is also covered by a Grazing Licence (Map 2). Other grasslands near Uncha Lake were also historically covered by a grazing licence, but tenures over this area were not renewed when they lapsed (B. Fowler *pers. comm.,* District Agrology Officer, Ministry of Forests and Range).

The Shannon Property is not covered by a grazing licence, because it was private property before being donated to BC Parks. However, the area has a history of grazing and will be currently grazed, and may have been sown to agronomic grasses (C. Peebles *pers. comm.,* local rancher). The present condition of these grasslands, whether the species composition is natural or not, is not known.

In addition to grasslands, 150 ha in the Red Hills are classified as rock on forest cover maps. This rock is mostly in the centre of the park on steep rocky slopes. These areas are sparsely treed, and very dry. Other open habitat types include 73 ha classified as non-productive brush in the Uncha Mountain portion of the park, and 75 ha classified as wetland (53 ha in the Uncha Mountain portion and 22 ha in the Red Hills).

Plant Communities and Plant Species at Risk

Uncha Mountain Red Hills Park contains a number of plant communities at risk (Table 8) as well as some significant old-growth forests on the lower slopes of Uncha Mountain. An inventory of the plant communities at risk has not yet been completed for the park, so information on them is lacking. Some sites were visited during the reconnaissance field trip for this project; however, there was not enough time to complete a full inventory.

Carex saximontana (Rocky Mountain sedge) was the only plant species at risk recorded in the park (de Groot and Bartemucci 2003). Taxonomists have now merged *C. saximontana* with *C. cordillerana,* and *C. cordillerana* is not considered at risk by the BC Conservation Data Centre. Like plant communities at risk, information on plant species at risk is lacking due to the lack of inventories.

Figure 1. SBSdk/81 grasslands above François Lake (upper photo) and Uncha Lake (lower photo)

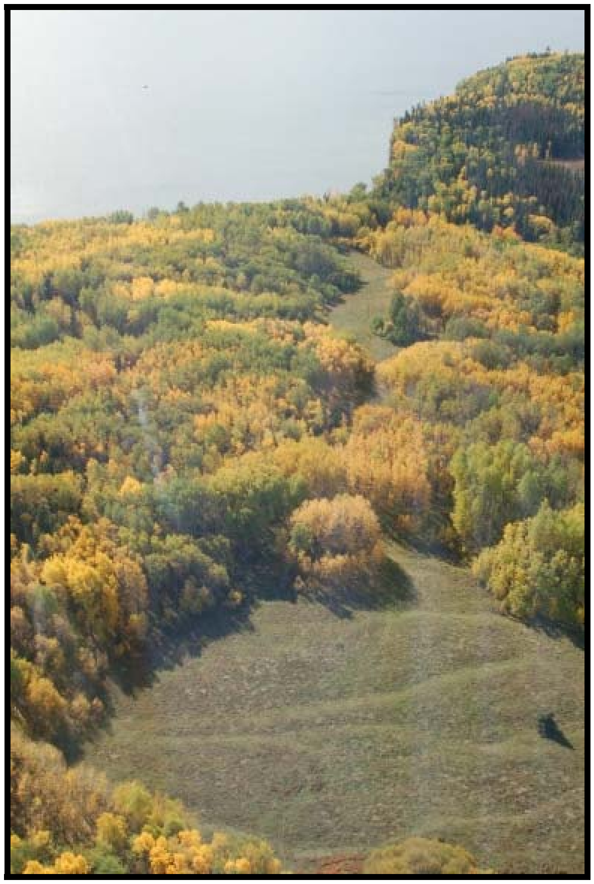


Figure 2. Aerial oblique view of Shannon property grassland

Table 8. Plant communities at risk that may occur in Uncha Mountain Red Hills Park[a]

Name	Subzone	List	Comments
02 Lodgepole pine - Juniper - Ricegrass	SBSdk	Blue	- Rocky south-facing ridge crests and other rapidly drained landforms. Occurrences on glaciofluvial terraces are of more conservation interest than those on rocky knolls as they are less common and are usually impacted more. - Occurrences on ridge crests were seen near Uncha Lake, but were not mapped as would be incomplete
04 Douglas-fir - Soopolallie - Feathermoss	SBSdk	Blue	- South-facing rocky knolls. A rare xeric juniper variation is found on rich bedrock at François Lake. - Douglas-fir occurrences in the Red Hills area are assumed to be this community. Douglas-fir occurrences in Uncha Mtn portion are mostly in SBSdw3 now, except for those on Uncha Mtn itself, and not rare, but may be more similar to those in the SBSdw3
08 Cottonwood - Dogwood - Prickly rose	SBSdk	Red	- Active floodplain of larger creeks; may occur on deltas of larger creeks on François Lake, i.e. Uncha Creek. - Cottonwood area visited was a devil's club dominated fan, called a seral stage of a SBSmc2/09 Spruce - Devil's club site association - unlisted (A. Banner *pers. comm.*, Research Ecologist, Ministry of Forests and Range)
81 Saskatoon - Slender - wheatgrass	SBSdk and SBSmc2	Red	- Dry south-facing slopes - Excellent representation above François Lake and Uncha

Table 8. Plant communities at risk that may occur in Uncha Mountain Red Hills Park[a]

Name	Subzone	List	Comments
82 Blue grass - Slender wheatgrass	SBSdk and SBSdw3	Red	- Dry south-facing slopes - Has not been seen in park, but may occur in Shannon Property
Other Douglas-fir communities; e.g.: Douglas-fir - Birch	SBSdk	No[b]	- Douglas-fir is rare in the SBSdk, park contains some of the best examples in the region, including a Douglas-fir - Birch - Spruce community of a fan near Uncha Mtn. - There are several forest cover polygons in the Uncha Mtn portion containing both Douglas-fir and birch, but they were not visited.
Aster - Peavine - Meadow rue meadows	SBSdk and SBSmc2	No[b]	- Occurs on level inactive fine-textured fluvial deposits, and gentle well-drained south-west facing slopes. Community has often been grazed. - Has not been seen in park, but may have small occurrences
Timber oatgrass dry grassland	SBSdk and SBSmc2	No[b]	- Occurs on level inactive gravely fluvial deposits from valley bottom to subalpine but well developed examples may be scarce. - Has not been seen in park, but may have small occurrences

a - list taken from de Groot and Bartemucci (2003) but modified; some information taken from Haeussler (1998)
b - Recommended listing of plant community based on preliminary fieldwork (Haeussler 1998).

2.1.2 Wildlife

Although no wildlife inventories have been conducted in Uncha Mountain Red Hills Park, the park likely contains wildlife typical of sub-boreal forests in the region. The Sub-Boreal Spruce biogeoclimatic zone contains some of the best habitat in the province for moose, black bear, marten and fisher (Banner *et al.* 1993). The SBSdk is drier and colder than other SBS subzones, making it favourable for ungulates that are avoiding deeper snow at higher elevations. The aspen stands found in the SBSdk provide favourable habitat for snowshoe hare, lynx, moose, mule deer and migratory birds. The natural grasslands in the SBSdk are favoured by some species, including raptors, coyotes, bluebirds, and some rodents (Banner *et al.* 1993). In the aspen forests of the SBSdk, breeding birds tend to be more abundant and diverse in older stands than in younger stands and in mixed conifer-aspen stand than in pure aspen stands (Pojar 1995).

Uncha Mountain Red Hills Park contains important ungulate winter range for both mule deer and moose. The south-facing slopes of Red Hills above François Lake and the south facing slopes on the north side of Uncha Lake are rated as very high and high value mule deer winter range (Map 5). These areas are dominated by aspen, and the warm south aspect means snow cover melts early in spring. These south facing slopes are also rated as very high and high value moose winter range, and are likely used by black bears during spring.

The majority of the Uncha Lake portion of the park east of Uncha Creek is rated as high value moose winter range, while the lower elevation areas west of Uncha Creek, surrounding Uncha Mountain and south to Uncha Lake are rated as very high value moose winter range (Map 5). The Shannon property is also rated as very high value moose winter range. During summer, moose and mule deer use all areas of the park, including higher elevations of Red Hills and Uncha Mountain.

Several local residents indicated during the consultation process that moose use of the park had decreased in recent times compared to 30 years ago. This was attributed to the maturation of the deciduous vegetation, which has become unpalatable to moose. Vegetation development can be seen clearly in the photos in section 6.3. Burning by First Nations may have been responsible for the younger vegetation present in the park in earlier times.

Uncha Mountain Red Hills Park consists of 3 separate parcels of land, 94 ha, 1,554 ha, and 7,773 ha in size. Although each parcel contains important wildlife habitat values, none of the parcels individually or combined are large enough to contain self-sustaining populations of most wildlife species other than some of the small mammals. The two larger parcels could potentially contain entire home ranges for some individuals, but the majority of medium and large sized mammals likely move in and out of the park during their seasonal cycle.

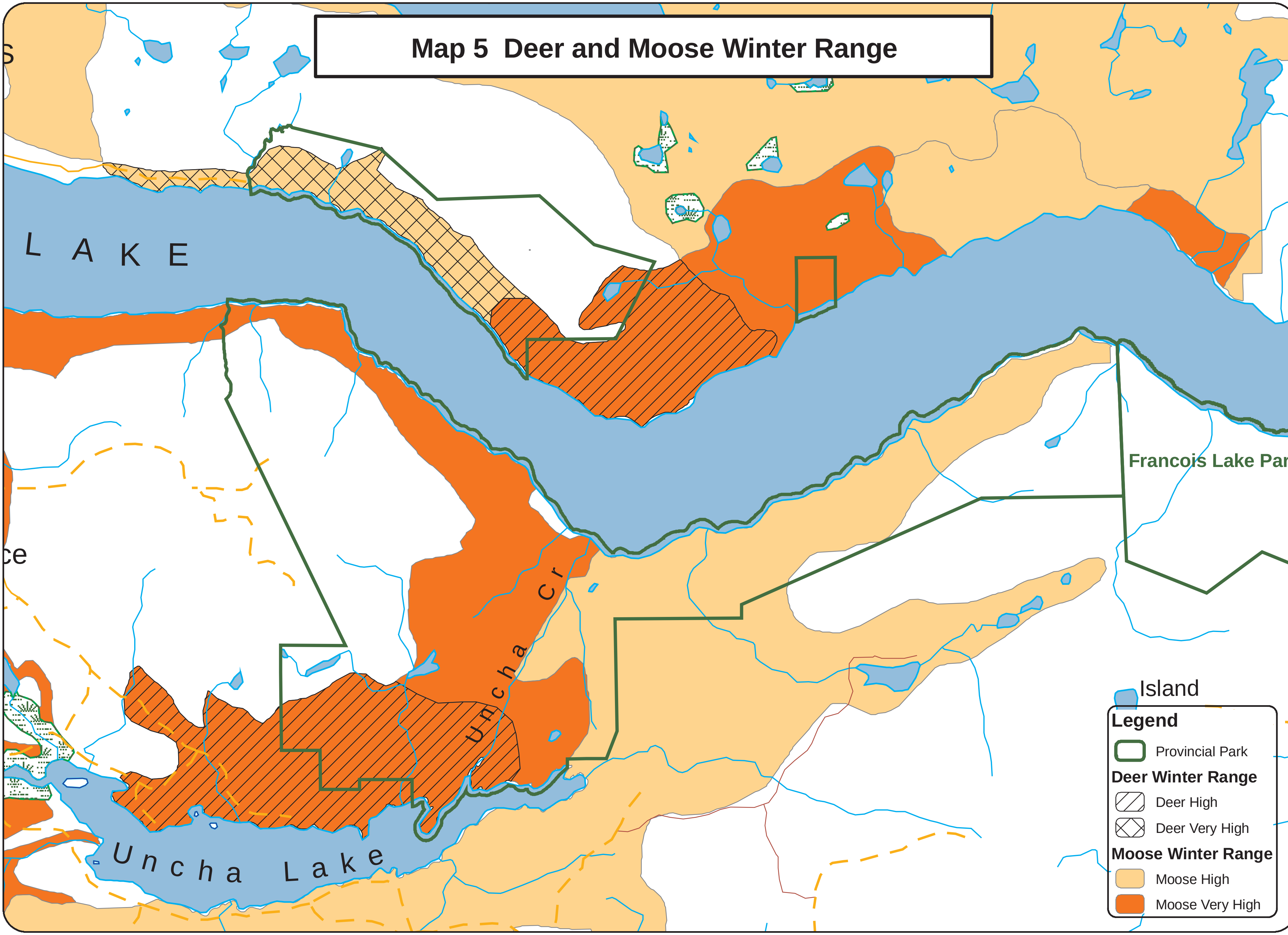
2.1.3 Fish

Uncha Creek connects Uncha Lake with François Lake, it is 5.6 km long and is the second largest watershed in the François Lake system. The Uncha Creek watershed includes Uncha, Binta, Takysie and Mollice lakes. It is the only fish-bearing waterway within Uncha Mountain Red Hills Park; though Peace Creek, which occasionally contains fish (Rosberg 1975, Bustard 1988), enters François Lake at the western edge of the Shannon Property.

Uncha Creek has excellent spawning potential in the lower reach, which is on a gravel fan, and in the upper reach adjacent to Uncha Lake. Beaver dams may restrict the movement of fish upstream beyond 1 km in some years, but there are no obstructions in the canyon in the midsection of the creek (Pinsent 1972, Bustard 1988). Bustard (1988) found Uncha Creek to account for 10% of the rainbow fry production in sampled tributary stream to François Lake (4^{th} rank of 8 streams), and 2% of the parr production (6^{th} rank). Low summer flow in Uncha Creek is in the range of 10 to 20 cubic feet per second (Bustard 1988).

2.2 Natural Disturbance Regimes

Fire and MPB are the two main large-scale forest disturbance agents responsible for the present vegetation pattern in Uncha Mountain Red Hills Park. Other forest insects also occur in the area. For example, Douglas-fir beetle was first detected in 1955 on the southeast shore of François Lake. Then in 1990, 300 Douglas-fir trees were killed on the northeast shore of François Lake. This beetle population was controlled by pheromone baiting and selective logging, but continued to kill mature and old Douglas-fir trees from 1991 to 1994 (Garbutt no date). The area attacked was outside the park, several kilometres to the east (B. Fowler *pers. comm.*, District Agrology Officer, Ministry of Forests and Range). Fire is discussed in the following section, while MPB is discussed in section 5.



Eclipse GIS
March 3, 2007

1 centimeter equals 1 kilometer

2.3 Fuel and Fire Dynamics

2.3.1 Fuel Characteristics Prior to the Mountain Pine Beetle Epidemic

The Canadian Fire Behaviour Prediction (FBP) System allows fire managers to predict fire behaviour characteristics such as rate of spread (m/min) and fire intensity (kW/m) by using models developed for specific types of forest stands or "fuel types". The Fire Behaviour Prediction System fuel type classifications were generated for the stands within the Park using an algorithm developed by the BC Ministry and Forests and Range Protection Program that converts forest vegetation inventory information to Fire Behaviour Prediction System fuel type classifications. This algorithm was not designed to classify stands with beetle-killed lodgepole pine and, at the present time, the Fire Behaviour Prediction System does not contain a model to predict fire behaviour for beetle-killed lodgepole pine.

The fuel types present in Uncha Mountain Red Hills Park prior to the MPB epidemic are listed below. The fuel types are colour-coded on Map 6 in terms of potential for extreme fire behaviour ranging from dark red representing the highest fire behaviour potential (C-2 – Boreal Spruce) to dark green representing the lowest fire behaviour potential (D-1 – Leafless Aspen). The hectares and percent of the park in each fuel type are presented in Table 9.

<u>C-2 – Boreal spruce</u>

This fuel type is characterized by pure, moderately well-stocked spruce stands on lowland and highland sites. Tree crowns extend to or near the ground. Low to moderate volumes of down woody material are often present.

<u>C-3 – Mature jack or lodgepole pine</u>

This fuel type is characterized by pure, fully stocked jack or lodgepole pine where the stands have matured to at least the stage of complete crown closure. The base of the live crown is well above the ground. A sparse conifer understory may be present.

<u>C-4 – Immature jack or lodgepole pine</u>

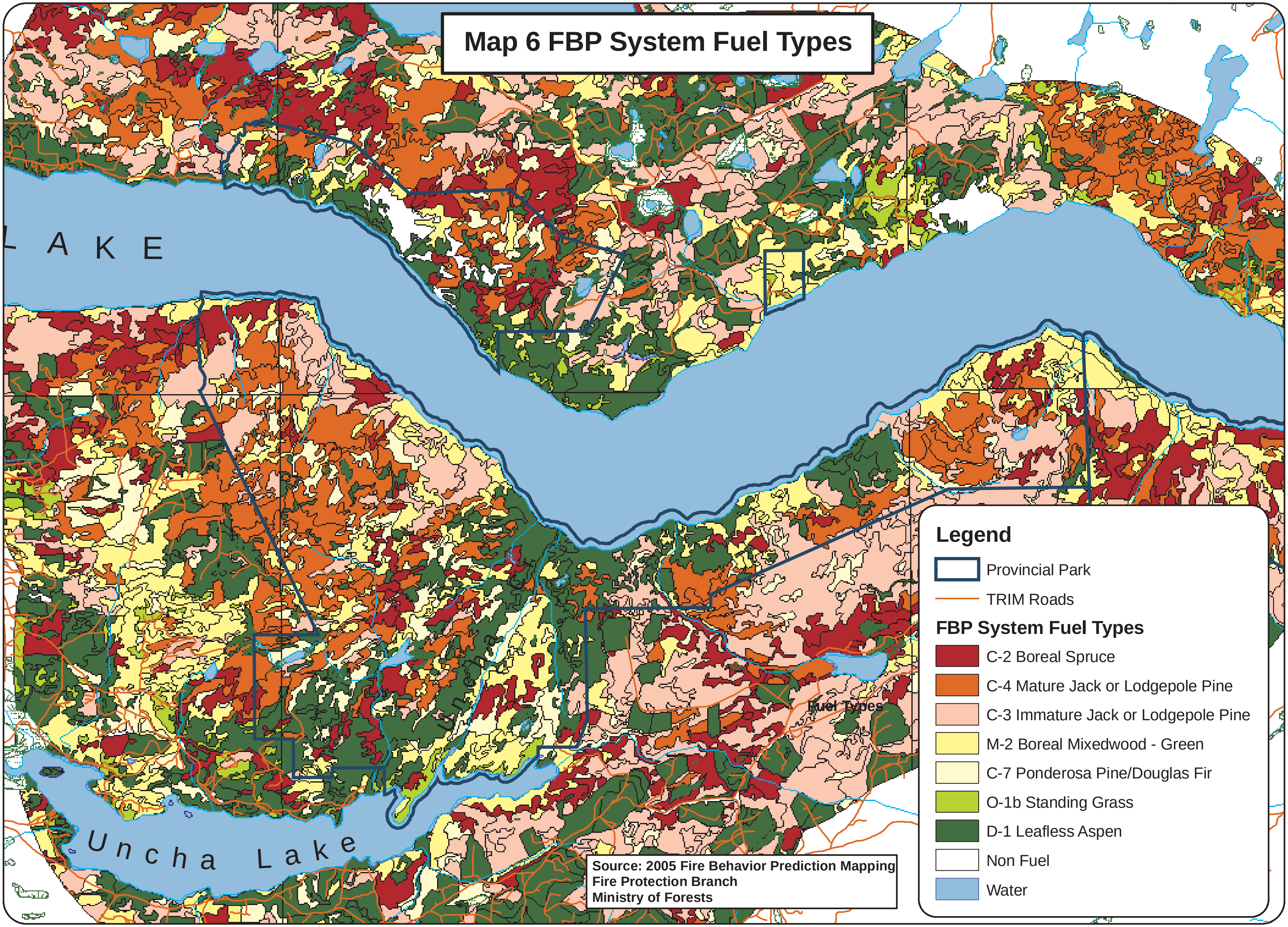
This fuel type is characterized by pure, dense jack or lodgepole pine stands (10,000 – 30,000 stems/ha) in which natural thinning mortality results in a large quantity of standing dead stems and dead down woody fuel. Vertical and horizontal fuel continuity is characteristic of this fuel type.

<u>C-7 – Ponderosa pine – Douglas-fir</u>

This fuel type is characterized by uneven-aged stands of ponderosa pine and Douglas-fir in various proportions. Western larch and lodgepole pine may be significant stand components on some sites and elevations. Stands are open with occasional clumpy thickets of multi-aged Douglas-fir and/or larch as a discontinuous understory. Woody surface fuels are light and scattered.

<u>M-2 – Boreal mixedwood – green</u>

This fuel type is characterized by stand mixtures consisting of the following coniferous and deciduous tree species in varying proportions: black spruce, white spruce, subalpine fir, trembling aspen and white birch. Rate of spread is weighted according to the proportion (expressed as a percent) of softwood and hardwood components.



March 10, 2007
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1 centimeter equals 1 kilometer

D-1 – Leafless aspen

This fuel type is characterized by pure, semi-mature trembling aspen stands.

O1: Grass

This fuel type is characterized by continuous grass cover, with no more than occasional trees or shrub clumps that do not appreciably affect fire behaviour. Two subtype designations are available for grasslands; one for the matted grass condition common after snowmelt or in the spring (O1-a) and the other for standing dead grass common in late summer to early fall (O1-b). The proportion of cured or dead material in grasslands has a pronounced effect on fire spread there and must be estimated with care.

Table 9. Fire Behaviour Prediction System fuel types present within Uncha Mountain Red Hills Park prior to mountain pine beetle epidemic

Area	Fire Behaviour Prediction System Fuel Types							Non-Fuel	Water	Total
	C-2	C-3	C-4	C-7	M-2	D-1	O-1b			
(ha)	848	1,237	2,071	868	1,606	2,093	118	151	430	9,421
(%)	9	13	22	9	17	22	1	2	5	100

The spatial distribution of fuel types present within and around Uncha Mountain Red Hills Park prior to the MPB epidemic, and subsequent mortality of lodgepole pine, shows a landscape with a wide range of fuel types. Within the park, most of the stands containing deciduous species (D-1, M-2) occur along Uncha Creek and along the shorelines on both the north and south sides of François Lake. Most of the more hazardous fuel types (C-2, C-3, C-4) occur on the northeast facing slopes of Uncha Mountain and at the higher elevations along the southern boundary of the park east of Uncha Creek.

A similar mixture of fuel type is also present in areas adjacent to the park. The north shore of François Lake is characterized by less hazardous fuel types (D-1 and M-2) on lower slopes, east of Red Hills and around the Shannon Property where aspen is more common, mixed with the more hazardous C-3 fuel type. On upper slopes where pine and spruce are more common, the more hazardous C-2 and C-4 fuel types are dominant.

Southeast of the Uncha Mountain portion of the park, where there are no residents, the fuel types are predominantly the more hazardous C-2, C-3 and C-4 fuel types. West and southwest of the park, where there are numerous ranches and residences the fuel types are change from the more hazardous C-2 and C-4 immediately adjacent to the park, to the less hazardous M-2 and D-1, with pockets of C-2, C-3 and C-4. The most hazardous fuel types west of the park are along François Lake where the C-2, C-3 and C-4 dominate.

2.3.2 Fuel Characteristics after the Mountain Pine Beetle Epidemic

Mountain pine beetle killed trees will change both the quantity and spatial distribution of forest fuels over time. The initial change in fuel characteristics following successful MPB attack is a change in the moisture content of the foliage as the needles die. Live foliar moisture contents vary seasonally and can range from a minimum of about 85% to a maximum of 120%. (Forestry Canada Fire Danger Group 1992). In contrast, the moisture content of red pine needles has been measured as low as 6% and will vary depending on temperature and relative humidity levels throughout the day (B.C.

Min. of Forests and Range Protection Branch unpubl. data 2004). This low moisture content in the red needles creates the potential for extreme crown fire behaviour and long spotting distances.

Approximately 2 to 5 years after the tree dies, these red needles fall to the ground, which increases the surface fuel loading. The increase in surface fine fuels can result in an increase in surface fire behaviour. This increase in surface fuel loading may decrease over time depending on site conditions and decomposition rates. As the red needles fall to the ground, the crown bulk density of the stand decreases which reduces the stand's ability to initiate and maintain an active crown fire. As the dead pine trees eventually fall to the ground, the surface fuel loading increases, which can result in fires with increased fire behaviour potential since more surface fuel is available for consumption. In terms of Uncha Mountain Red Hills Park, most of the stands will have progressed beyond the red-needle stage by the summer of 2007.

Research on dead tree fall rates is on-going, but Hawkes *et al*. (2005) reported that in the Chilcotin Plateau and Kamloops Forest Region, the density of standing dead pine in sampled stands 18 years post attack were reduced by 52% (289 to 140 stems/ha) and 26% (370 to 273 stems/ha), respectively. The Forest Practices Board (2007) found that 55% of dead trees had fallen 25 years after MPB attack in the Sub-Boreal Pine Spruce (SBPS) zone, an area drier than Uncha Mountain Red Hills Park. Fall down rates within the park are yet to be determined; however, given the studies to date, it is reasonable to assume that surface fuel loading will continue to increase for the next 10-30 years. Predictions for the drier part of the Sub-Boreal Spruce zone are that 25-50% of attacked trees will have fallen ten years after they are attacked (Lewis and Hartley 2005).

The change in tree species composition will also change the fuel type of stands where pine was a leading or secondary species. Five fuel types in the park had lodgepole pine as a leading species prior to the MPB epidemic (Table 10). Where lodgepole pine is the dominant species, in the C-3, C-4 and C-7 fuel types, it is expected that these stands will shift more towards a C-2 fuel type as the secondary species (spruce and subalpine fir) respond to increased growth rates and become the dominant species. Assuming close to 100% pine mortality, this shift in fuel types would add approximately 4,000 hectares to the more hazardous C-2 classification. The M-2 fuel type (225 ha) will likely shift towards the less hazardous D-1 fuel type as the percentage of live conifer in this mixed stand is reduced from the pine mortality. The D-1 fuel type (211 ha) will also become less hazardous for the same reason.

Table 10. Fire Behaviour Prediction System fuel types containing lodgepole pine as the leading species in Uncha Mountain Red Hills Park prior to mountain pine beetle epidemic

(% Pine)	C-3		C-4		C-7		M-2		D-1		Total	
	Area (ha)	(%)	Area (ha)	(%)	Area (ha)	(%)	Area (ha)	(%)	Area (ha)	(%)	Area (ha)	(%)
40-50	331	8	582	13	317	7	88	2	40	1	1,358	31
51-60	130	3	316	7	189	4	35	1	19	0	688	16
61-70	140	3	379	9	135	3	40	1	30	1	723	16
71-80	199	5	102	2	140	3	62	1	65	1	567	13
81-90	163	4	445	10	36	1	0	0	35	1	678	15
91-100	81	2	248	6	31	1	0	0	22	1	381	9
Total	**1,043**	**24**	**2,071**	**47**	**847**	**19**	**225**	**5**	**211**	**5**	**4,396**	**100**

Five fuel types in the park had lodgepole pine as secondary species prior to the MPB epidemic (Table 11). In the case of stands initially classified as C-3 and C-7, the removal of the secondary pine component from these stands will also tend to shift the fuel type classification towards C-2 adding approximately another 200 hectares to this more hazardous fuel type.

Table 11. Fire Behaviour Prediction System fuel types containing lodgepole pine as the secondary species within Uncha Mountain Red Hills Park prior to mountain pine beetle epidemic

(% Pine)	C-2		C-3		C-7		M-2		D-1		Total	
	Area (ha)	(%)	Area (ha)	(%)	Area (ha)	(%)	Area (ha)	(%)	Area (ha)	(%)	Area (ha)	(%)
0-10	25	2	0	0	0	0	39	3	23	2	87	7
11-20	187	16	0	0	21	2	25	2	12	1	245	21
21-30	181	15	118	10	0	0	49	4	74	6	422	35
31-40	350	29	76	6	0	0	0	0	0	0	426	36
41-50	10	1	0	0	0	0	0	0	0	0	10	1
Total	**754**	**63**	**194**	**16**	**21**	**2**	**112**	**9**	**109**	**9**	**1,190**	**100**

Although the shift in species composition to spruce and subalpine fire may change the fuel type to a C-2 classification, as these species have a higher fire hazard rating, the loss of needles from the dead pine trees will reduce the crown bulk density of the stands, which will reduce the potential for active crown fire behaviour, until a new crown is formed.

Since the current Fire Behaviour Prediction System fuel types were developed for natural stands without large quantities of beetle-killed surface fuels, it is likely that fires in these stands will exhibit fire behaviour characteristics beyond what is predicted by the Fire Behaviour Prediction System once the surface fuels increase due to fall down of the lodgepole pine.

2.3.3 Fire Weather Climatology

The closest B.C. Forest Service network weather station to the Park is the Grassy Plains weather station, which is located approximately 23 km due east of the Park (Lat. 53º 56' 48"; Long. 125º 52' 0"; Elevation 1076 m). The period of record for this station is 1970 to the present. The average noon temperature reaches a high of 17º in July and August and the noon wind speed is very consistent and averages approximately 9 km/h over the most of the fire season (Table 12). The most prevalent wind direction is 270 degrees throughout the fire season.

Table 12. Average noon weather readings from Grassy Plains Weather Station (1970–2006) by month

Month	Temp. (ºC)	RH (%)	Windspeed (km/hr)		Wind Direction Frequency (%)			
	Avg.	Avg.	Avg.	90^{th} %	0-90º	90-180º	180-270º	270-360º
May	11.0	54	10.9	21.0	21	11	28	40
June	14.4	58	9.6	18.4	28	8	22	42
July	16.9	58	9.1	18.0	25	8	21	46
August	17.0	57	9.1	18.0	28	8	22	42
Sept.	12.6	64	9.1	19.0	27	10	27	37
Oct.	6.2	73	9.1	20.9	13	17	41	29

The 50th and 90th percentile values for the following components of the Canadian Fire Weather Index (FWI) System are presented in Figure 3.

The Fine Fuel Moisture Code (FFMC) is a numeric rating of the moisture content of litter and other cured fine fuels. This code is an indicator of the relative ease of ignition and the flammability of fine fuel.

The Duff Moisture Code (DMC) is a numeric rating of the average moisture content of loosely compacted organic layers of moderate depth. This code gives an indication of fuel consumption in moderate duff layers and medium-size woody material.

The Drought Code (DC) is a numeric rating of the average moisture content of deep, compact organic layers. This code is a useful indicator of seasonal drought effects on forest fuels and the amount of smouldering in deep duff layers and large logs.

The Initial Spread Index (ISI) is a numeric rating of the expected rate of fire spread. It combines the effects of wind and the FFMC on rate of spread without the influence of variable quantities of fuel.

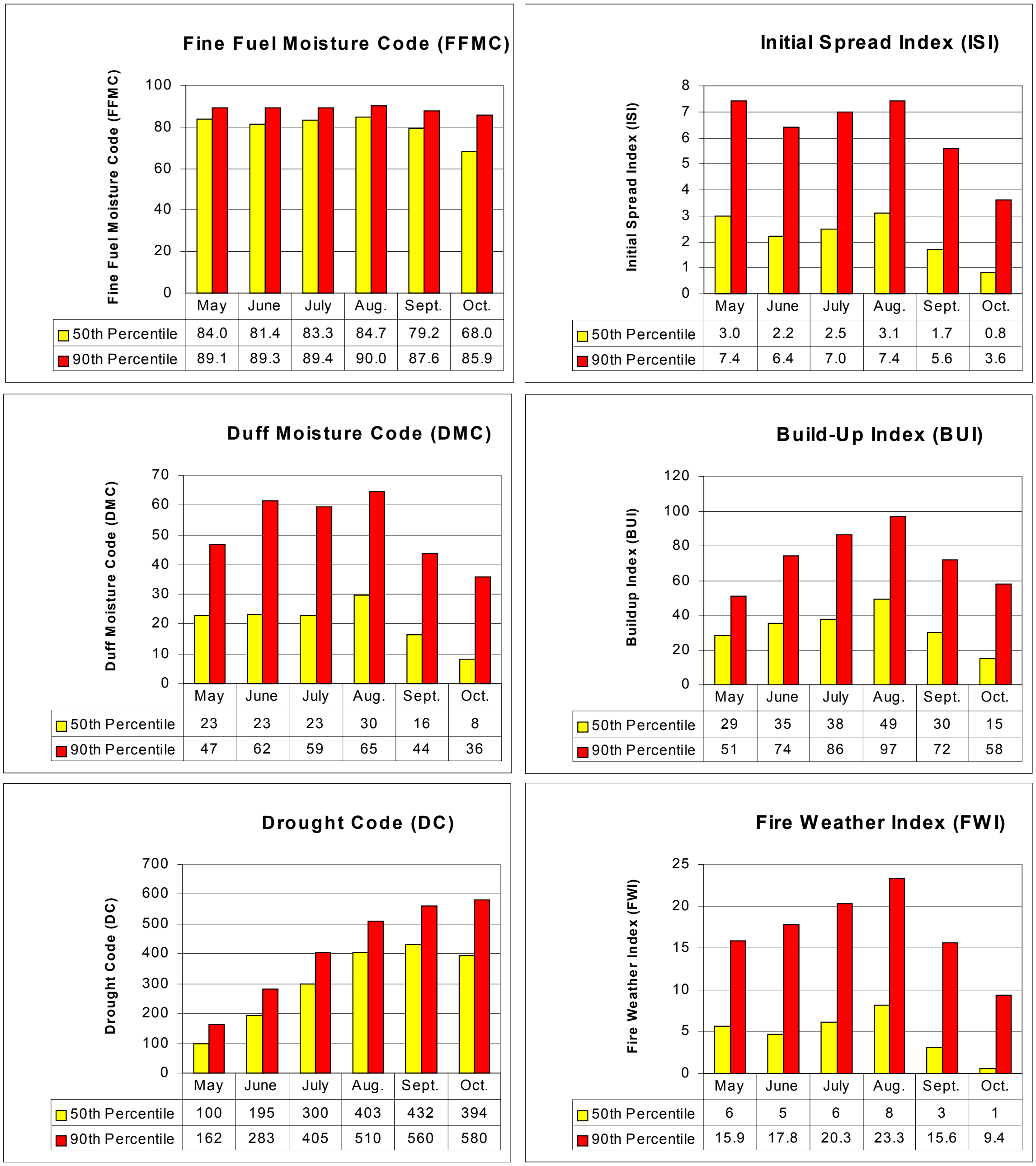
The Buildup Index (BUI) is a numeric rating of the total amount of fuel available for combustion. It combines the DMC and the DC.

The Fire Weather Index (FWI) is a numeric rating of fire intensity. It combines the Initial Spread Index and the Buildup Index. It is suitable as a general index of fire danger throughout the forested areas of Canada.

The peak Buildup Index (BUI) and the peak Fire Weather Index (FWI) occur in August. Also of note are the relatively low 50th and 90th percentile values of Fine Fuel Moisture Code (FFMC) and Initial Spread Index (ISI). The effect of these relatively low values of FFMC and ISI at the 50th and 90th percentile level can be seen in the low percentage of days that continuous crown fire would be expected in all fuel types (Appendix 2).

2.3.4 Fire Behaviour Potential

The 90th percentile rate of spread (m/min) and fire intensity (kW/m) (by fuel type and month) were calculated using the Fire Behaviour Prediction System and the noon weather observations from the complete historical record of the Grassy Plains weather station (assuming level terrain) (Figure 4). It is clear that the C-2, C-4 and M-2 (75% conifer) fuel types have the potential to exhibit the most severe fire behaviour throughout the fire season in terms of rate of spread and fire intensity.



Fine Fuel Moisture Code (FFMC)

	May	June	July	Aug.	Sept.	Oct.
50th Percentile	84.0	81.4	83.3	84.7	79.2	68.0
90th Percentile	89.1	89.3	89.4	90.0	87.6	85.9

Initial Spread Index (ISI)

	May	June	July	Aug.	Sept.	Oct.
50th Percentile	3.0	2.2	2.5	3.1	1.7	0.8
90th Percentile	7.4	6.4	7.0	7.4	5.6	3.6

Duff Moisture Code (DMC)

	May	June	July	Aug.	Sept.	Oct.
50th Percentile	23	23	23	30	16	8
90th Percentile	47	62	59	65	44	36

Build-Up Index (BUI)

	May	June	July	Aug.	Sept.	Oct.
50th Percentile	29	35	38	49	30	15
90th Percentile	51	74	86	97	72	58

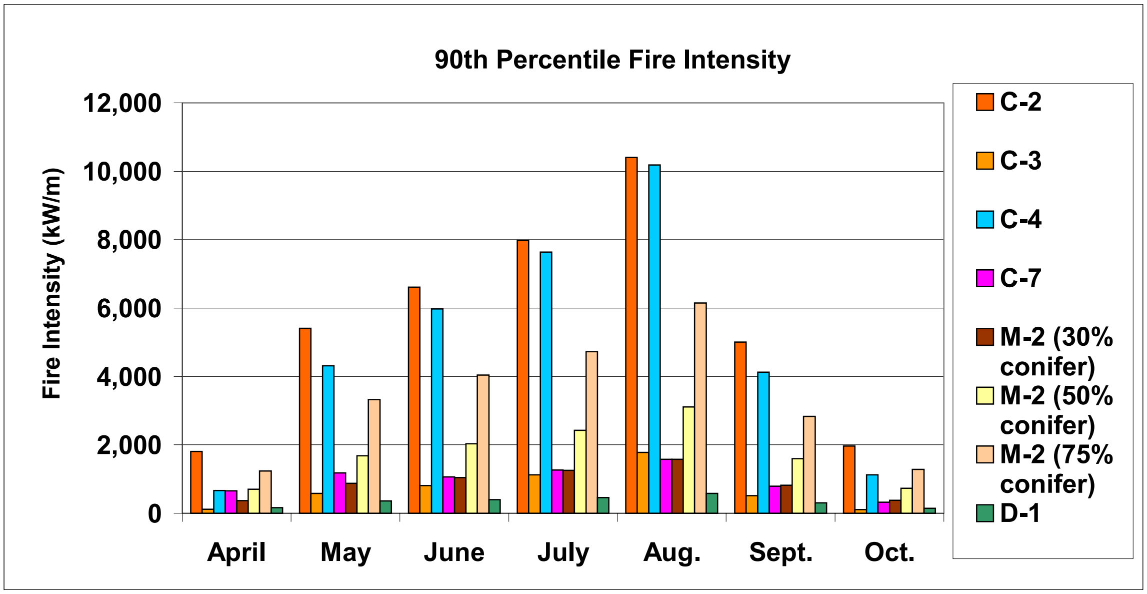
Drought Code (DC)

	May	June	July	Aug.	Sept.	Oct.
50th Percentile	100	195	300	403	432	394
90th Percentile	162	283	405	510	560	580

Fire Weather Index (FWI)

	May	June	July	Aug.	Sept.	Oct.
50th Percentile	6	5	6	8	3	1
90th Percentile	15.9	17.8	20.3	23.3	15.6	9.4

Figure 3. 50th and 90th percentile Fire Weather Index System components by month for Grassy Plains weather station (1970 – 2006)



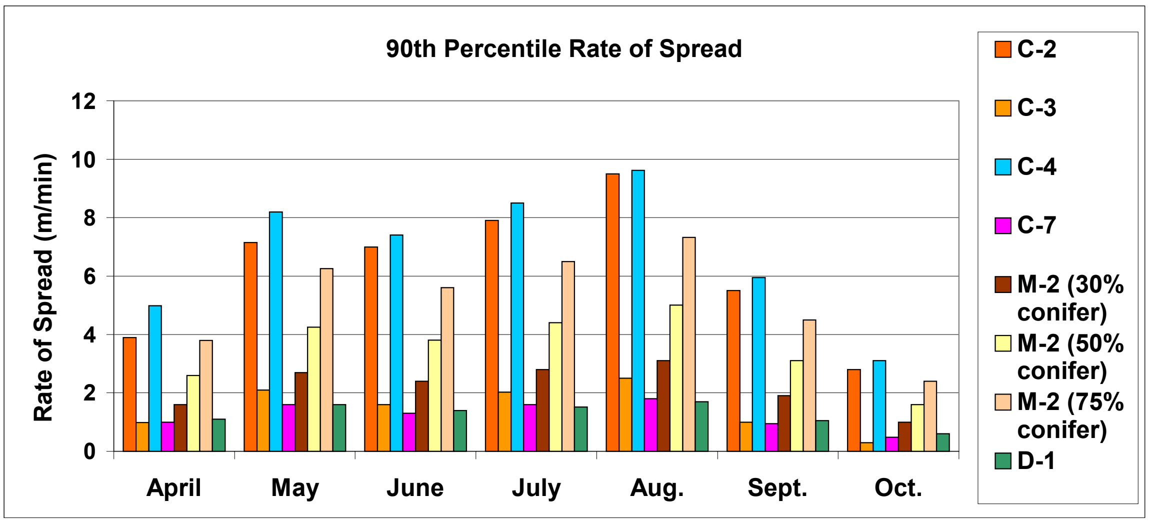


Figure 4. 90th percentile Rate of Spread and Fire Intensity by month for Grassy Plains weather station (1970–2006)

The expected 90th percentile fire intensity for C-2, C-4 and M-2 (75% conifer) exceeds 4,000 kW/m from June through August and fires burning at this intensity level would be expected to spread as intermittent or continuous crown fires. In contrast, the 90th percentile fire intensity of the remaining fuel types (C-3, C-7, D-1, M-2 (30% and 50% conifer)) rarely if ever exceeds 2,000 kW/m and would be limited to surface fire with some intermittent crowning throughout the fire season. The fire intensity and rate of spread of the grass fuel types (O-1a and O-1b) depends on the percentage of cured grass, and the total grass fuel load which will vary throughout the season. Early spring prior to green-up and late fall after curing are the times of the year that grass fires will exhibit their greatest fire behaviour potential.

The percentage of days within each month, for each fuel type, that a fire would be expected to spread as a surface, intermittent and continuous crown fire were calculated based on the calculated crown fraction burn for all of the noon historical records from the Grassy Plains weather station (Appendix 2). Fires with a crown fraction burned value of less than 0.1 are expected to spread as surface fires, 0.1 to 0.90 as intermittent crown fires and >0.9 as continuous crown fires. The number of days per month that weather conditions would support continuous crown fire within the park is quite low. For example, the most hazardous fuel type (C-2) would only be expected to exhibit continuous crown fire behaviour on an average of 7.5% of the days during the month of August. In contrast, the percentage of days where continuous crown fire is possible in the C-3, C-7, M-2 (30% and 50% conifer) fuel types is less than 1%.

Another way of looking at potential fire behaviour by month and fuel type is through a similar analysis of fire intensity classes. The 6 fire intensity classes are based on the following fire intensity (kW/m) levels:

Intensity Class 1:	<10 kW/m
Intensity Class 2:	10 – 500 kW/m
Intensity Class 3:	500 – 2,000 kW/m
Intensity Class 4:	2,000 – 4,000 kW/m
Intensity Class 5:	4,000 – 10,000 kW/m
Intensity Class 6:	>10,000 kW/m

Appendix 2 also shows the percentage of days expected for each fire intensity class within each month, for each fuel type. Fires burning with intensities > 10,000 kW/m (Fire Intensity Class 6) are considered extreme and have historically been possible on an average of 10% of the days in August for the C-2 and C-4 fuel types. In contrast, weather conditions necessary to support Fire Intensity Class 6 in the C-3, C-7, M-2 (30% and 50% conifer) and D-1 fuel types never exceeds 2% of the days in August.

2.3.5 Fire History in the Park

The relatively low number of days where extreme fire behaviour is possible is also reflected in the fire history in and around the park. Since 1950, a total of 16 fires have been recorded in the provincial database. Four of the fires (25%) were lightning caused, 11 of the fires (69%) were human caused and the cause of the remaining fire was undetermined. Thirteen of the fires were less than 2 hectares in size and the remaining 3 fires burned 8.2, 15.7 and 94 hectares. Evidence of historical fires occurs throughout the park and fire scars were observed in all but one of our field trip stops.

2.3.6 Post-MPB Fire Behaviour Predictions

At the present time our knowledge of fire behaviour potential and characteristics within beetle killed pine stands is limited. In 2004, the B.C. Ministry of Forests and Range Protection Branch initiated a fire behaviour study at Carrott Lake south of Vanderhoof. The purpose of this project is to study red-attack MPB stands and to quantify the effects of MPB on fuel moisture, ignitability and other fire behaviour characteristics such as rate of spread, fire intensity, and crowning potential. Two test fires were completed in 2006; however, not enough data has been collected yet to generalize fire behaviour in red-attack MPB stands. More work is planned at Carrott Lake and in documentation of wildfires and prescribed fires in MPB-killed stands (Nathalie Lavoie *pers. comm.,* Leader, Fire Sciences, Ministry of Forests and Range)

Most of the stands within the park are moving beyond the red needle stage and the fire behaviour potential of these beetle-killed stands over the longer term is more relevant to the stands within the park. Since our knowledge of fire behaviour in older beetle-killed stands is extremely limited at present, the B.C. Ministry of Forests and Range Protection Branch is planning to address this knowledge gap in fire behaviour by gathering data on wildfires and prescribed burns in beetle-killed forests. However, until data is collected and local models developed to predict fire behaviour in beetle-killed stands, our best estimates will have to rely on published research from the United States and from local fire behaviour expertise. In the long-term, as trees fall in MPB-killed stands fuels build-up, the fire behaviour potential may need to be reassessed and potential mitigation strategies developed.

2.3.7 Summary

Currently, fuel characteristics of the stands within the park are similar to the surrounding areas around the park and are not more hazardous than stands in the surrounding areas. Likewise, fire behaviour potential of stands within the park are not greater than that in the surrounding areas. Adjacent areas with the most hazardous fuel types are located southeast of the Uncha Mountain portion of the park and at the crest of the Red Hills. The most heavily developed areas adjacent to the park, west of Uncha Mountain and west of the Red Hills, are dominated by fuels with lower fire behaviour potential fuel types, or a mix of fuel types.

Post-MPB, the fuel types in the park will change over time. In the red attack stage there is an increase in fire risk due to the low moisture content of the dead pine needles, both on the trees and after they fall. Crown fire risk will decrease as needles fall and ground fire risk will decrease as needles decompose. As dead trees fall, surface loading of fuels will increase, but research of fire dynamics with these fuel characteristics is lacking.

Stands may change to different fuel types as the species composition of stands change and as the understory trees grow. Mixed conifer stands may change to a more hazardous fuel type as pine dies out and other more hazardous conifer species, such as spruce and subalpine fir, become dominant. Mixed coniferous/deciduous stands may change to less hazardous fuel types as deciduous species become more dominant.

Values of the fire weather index system components are relatively low for the Uncha Mountain Red Hills Park area throughout the fire season. The fuel types with the highest fire behaviour ratings may support crown fires but the number of days in which conditions would allow a crown fire to carry are relatively few, based on weather data collected at the nearby Grassy Plains weather station.

More research is needed on fuel types and fire behaviour in a post-mountain pine beetle landscape.

2.4 Cultural Values

Uncha Mountain Red Hills Park covers portions of seven First Nations traditional territories. The entire park is within the territories of the Burns Lake Band, Nee Tahi Buhn Band, Office of the Wet'suwet'en, Skin Tyee Band, and the Wet'suwet'en First Nation. The eastern half of the park is within the territories of the Nadleh Whut'en Band and the Stellat'en First Nation

Uncha Mountain Red Hills Park contains numerous cultural values, and is still used by First Nations groups for traditional hunting, fishing and trapping activities. Specific values include: fish camps that operated at both ends of Uncha Creek on Uncha and François lakes; culturally modified trees on Uncha Mountain; a heritage trail that links Uncha and François lakes and then travels east along François Lake; a trail that may be part of a Grease Trail system running through Red Hills; two archaeological sites on Uncha Lake at Uncha Creek (Richards 1981); and, red dye sources on the Red Hills. Additional archaeological sites are likely to occur in the park, especially on the shores of François Lake, based on anecdotal reports of historical First Nations use. Also three archaeological sites are located outside the park on the south shore of Uncha Lake opposite Uncha Creek.

2.5 Recreational Values

Most recreational use of the area is on the adjacent François and Uncha lakes and their shorelines, but terrestrial areas are also used recreationally. Several trails in the park are commonly used. The Grease Trail in Red Hills, starting at the western boundary, has been used as a pack trail and is now used primarily as a hiking trail with some horse and running use. This trail has been cleared of obstructing vegetation by a running group that uses the park.

A rough hiking trail is located on the north face of Uncha Mountain. Several other trails are used by horse riders including: one that starts from private land west of the Uncha Mountain and leads into the park; and, a trail that starts from private land at Uncha Lake and leads to the unnamed Y-shaped lake in the park, and then on to François Lake. Snowmobiles may also use some of these trails, and also may use existing forestry roads that lead into the park, such as Uncha Mountain Road.

2.6 Other values

Other uses of the park include:

- four traplines, two of which are active in the park; there are also two trapline cabins in the park;
- three guide-outfitter territories, one of which is active in the park;
- a RCMP repeater station on Uncha Mountain; and,
- two grazing permits (Map 2)
    - one that covers the entire Red Hills area held by Charles and Sheralynn Peebles. (The grazing tenure holders did not put cattle in the Red Hills area in 2005 or 2006, due to problems with fencing in the area, but they plan to graze the Red Hills again in 2007); and
    - one that covers a small area in the southwest corner of the Uncha Mountain portion held by Nathan and Elly Foote.

2.7 Values on Adjacent Lands

Management actions within Uncha Mountain Red Hills Park could affect infrastructure and uses adjacent to the park (Map 2). A number of ranches are located along the western and southern boundaries of the Uncha Mountain portion and on the western boundary of the Red Hills portion, which includes homes and farm buildings. Also, private lands are located east of the Red Hills portion and partly surrounding the Shannon Property; some of these have residences or holiday homes.

A number of small holdings with residences are located on François Lake at the western edge of the Red Hills, and on Uncha Lake near the southwest corner of the park. Two Indian Reserves are located west of the Uncha Mountain portion: Cheslatta IR#1 and Skins Lake IR#16B. There are no private holdings near the eastern boundary of the Uncha Mountain portion of the park.

The crown lands surrounding the park are part of the forest harvesting land base, with substantial investments in post-harvest silviculture. Some of this investment has been lost due to MPB attack, especially older plantations near Uncha Mountain. This includes a silviculture reserve for research purposes held by the Ministry of Forests on Uncha Mountain; trees in this reserve have been killed by MPB and the reserve is no longer active (P. LePage *pers. comm.,* Research Silviculturist, Ministry of Forests and Range). Adjacent crown lands may also have grazing tenures over them, including investments in fencing to control cattle movements.

3 BC Parks Policy and Management Framework

3.1 BC Parks Vegetation Management Policy

When providing management direction to BC Parks, it is important to fit this direction within the policy framework of the agency. BC Parks has a Vegetation Management Policy to guide managers. This policy contains 10 components, several of which contain direction relevant to this project. General policy and relevant direction from these components are given below.

BC Parks Vegetation Management Policy Components (BC Parks 1999)

- Management for Representation
- Management for Biological Diversity
- ***Management of Ecosystem Processes***
- Conservation and Use
- ***Management of Special Features***
- ***Ecosystem Manipulation of Vegetation***
- ***Management for Restoration***
- Collection of Vegetation
- Management of Exotic Plant Species
- Management of Knowledge

Management of Ecosystem Processes

"*Natural ecosystem processes affecting vegetation including fire, insects, disease, weather (i.e., wind, avalanches, etc.), herbivory by wildlife, and tree mortality due to age, are recognized as natural occurrences shaping vegetation. Ecosystems will be managed to maintain ecological processes in as natural a state as possible.*" (BC Parks 1999)

- Vegetation management in British Columbia's protected areas will normally aim at maintaining functioning ecosystems, rather than emphasizing single species.
- Vegetation species as well as ecological processes affecting them will be maintained in as natural a state as possible.
- BC Parks' primary responsibility in fire management, after the protection of life and property, is to maintain natural ecosystems within parks and ecological reserves.
- Prescribed burning may be used as a tool to reintroduce natural fire events where fire suppression has effectively removed it from the ecosystem or to reduce fuel accumulations that have become a fire hazard (e.g., blowdowns).
- As burned areas are prime sites for alien plant invasions, invasive plant monitoring and control will be carried out following all wild and prescribed fires in protected areas.

Management of Special Features

"*Management priority will be given to special or unique vegetation communities, rare, threatened, and endangered species.*" (BC Parks 1999)

- Recognizing that the protection of rare and unusual habitats and ecosystems is important to conservation goals and to the protection of endangered, threatened, and vulnerable species, rare habitats will be identified and fully assessed.

Ecosystem Manipulation of Vegetation

"*Deliberate manipulation of vegetation may occur in parks and ecological reserves under special circumstances*." (BC Parks 1999)

Situations where manipulation may occur include those where:

- natural processes put irreplaceable forest stands, species or specimens of plants at risk,
- restoration of natural processes is desirable (i.e., reintroduction, fire), and
- where fire suppression has altered the natural vegetation pattern over the landscape.

Management for Restoration
"*Restoration of natural ecosystem processes and major vegetative and landscaping projects within British Columbia's park and ecological reserve system will use native plant species appropriate to the site and ecosystem*." (BC Parks 1999)

- BC Parks will endeavour to restore disturbed or lost natural ecosystem processes where compatible with essential protected area objectives. Examples are reforestation of logged or human-damaged forested areas, restoration of natural fire regimes or of predator/prey relationships. An essential condition of all restoration programs is the necessity for follow-up effectiveness surveys.

This policy contains clear direction that maintaining natural processes and ecosystems are a priority in protected areas, and that prescribed fire is an acceptable activity in certain situations. Priority is given to rare species and plant communities when managing protected areas, and intervention into natural processes to maintain them is acceptable. A broad view of restoration is taken, which includes the restoration of ecosystem processes as restoration. In this context it could be argued that prescribed fire is ecosystem restoration, with fire suppression activities having been the degrading force.

3.2 Uncha Mountain Red Hills Park - Existing Management Direction

Existing management direction for Uncha Mountain Red Hills Park comes from the Lakes District Land and Resources Management Plan (LRMP) (Government of British Columbia 2000) and the Uncha Mountain Red Hills Management Direction Statement (Ministry of Water, Land and Air Protection 2003). Management direction in these plans that is relevant to this document is summarized in Table 13 and Table 14.

Table 13. Relevant direction for protected area management in the Lakes District LRMP.

Objective	Management Strategy
To protect adjacent resource values and private property, as appropriate, from natural disturbances in protected areas.	1. Natural occurrences (e.g., fires, insects, and forest disease) within park boundaries will be managed to respect resource values both within and adjacent to park areas. This will be achieved by a district Memorandum of Understanding to be developed between Parks and Ministry of Forests. It should consider joint determination of the point at which natural occurrences within parks become a risk to adjacent values, and the appropriate action to be taken to reduce said risk (using available management options). 2. Where land management includes prescribed burning, fire management plans will be developed for areas within new parks to protect public safety, facilities and resource values on adjacent lands.
To maintain ecosystem representation and integrity, and ensure protection of key resource values and natural features.	1. Park management emphasis will be placed on maintaining the ecosystems, resource values and natural features for which protected areas were established. 2. Management interventions will not significantly alter natural ecological, hydrological and geomorphic processes except for express management purposes as defined by a protected area management plan. 3. Vegetation management will be undertaken, where appropriate, where previously open forests and grasslands have become ingrown as a result of fire suppression. Fire will be the primary means of restoring natural grasslands for conservation purposes only.
To ensure protection of key species and their habitats.	1. BC Parks will work with other agencies to ensure connectivity of wildlife habitat between parks and surrounding areas. 2. Opportunities to establish benchmarks for scientific study and management of rare, endangered and at risk species will be investigated. 3. Rare, endangered and at risk species, and their habitats, will be protected. 4. Habitat, cover and site-specific features for non-key fish and wildlife species will be considered in management processes.

Table 14. Relevant direction for protected area management in the Uncha Mountain Red Hills Park Management Direction Statement.

Objective	Strategies
To protect the natural values within Uncha Mountain Red Hills Provincial Park	1. Complete an inventory of fauna and flora within the parks and protected area with priority given to rare and/or sensitive grassland, scrub-steppe and forested ecosystems. 2. Develop a vegetation management plan based on the data collected in the inventory of flora with the goal of maintaining rare and/or sensitive grassland, scrub-steppe and forested ecosystems and rare species. The vegetation management plan should consider the following: • Inventory and map rare and/or sensitive ecosystems; describe ecosystem status and potential threats: - aspen and shrub encroachment onto grasslands because of fire control; - decreased regeneration of Douglas-fir because of fire control; - soil compaction and erosion caused by recreation, grazing, motorized use associated with grazing, and other activities; - invasion by non-native weeds caused by recreation and activities associated with grazing; changes in plant community composition because of grazing and recreation. • Work with appropriate government agencies, First Nations and Ministry of Water, Land and Air Protection ecologists to inventory threats, including roads, trails, facilities, grazing effort, motorized use (in association with established tenures) and outdoor recreation levels, and to estimate natural disturbance levels. • Design appropriate monitoring, management and restoration activities, including prescribed fire in association with girdling, hinging and other techniques; consider recommendations from the report to the Terrestrial Ecosystem Restoration Program, entitled "Restoration of native grasslands in the Prince Rupert Forest Region". 3. Prepare a fire management plan that considers prescribed burns as well as fire control to maintain grassland ecosystems; consult with local communities and First Nations before implementing any prescribed burns.
Consultation and Future Planning	Environmental Stewardship Division will consult with appropriate First Nations, stakeholders and community groups as issues arise. A particular challenge will be maintaining sensitive grassland, scrub-steppe and Douglas-fir ecosystems while allowing domestic cattle grazing, outdoor recreation use and preventing wildfire. A vegetation management plan and fire management plan, to be developed over the next five years, will provide guidance in maintaining these ecosystems.

The management direction in the Lakes LRMP, places an emphasis on allowing natural processes to occur, while also protecting values inside and adjacent to the park that may be affected by those processes. Management intervention must not significantly alter natural processes; however, vegetation management is acceptable to protect rare vegetation types.

Management direction in the Management Direction Statement is more specific than in the LRMP regarding the types of plant communities involved. Prescribed fire and mechanical vegetation manipulation are indicated as acceptable methods of vegetation management. However, assessments of the appropriateness of any management activities and a complete inventory are needed before activities are to take place.

4 Methods

4.1 Field trip and Airphoto Analysis

Information presented in this document is primarily summarized from existing information. Fieldwork for the project consisted of a 2-day visit to Uncha Mountain Red Hills Park to get an overview of the park and to visit as many of the rare ecosystems as possible. On the first day, a Beaver floatplane was used to fly over the park and to land at several locations on François Lake for site investigations. On the second day, road accessible portions of the park were visited, including Red Hills, Uncha Mountain and Uncha Lake.

At each site, *Ground Inspection Forms* (GIF) were filled out to obtain ecological information on the area. Information on the MPB status of the area, fuel loading, fire potential, ungulate winter range, and successional history was also collected. The overview flight allowed us to gain a good idea of the extent and severity of tree mortality due to MPB attack in the park and surrounding areas.

We used historical airphotos to investigate the changes in grassland extent over time in the study area, though we were restricted to a 58-year time span in photo availability (Table 15). The photos used were obtained digitally or the originals were scanned. For each area of known grassland or other rare community, we zoomed into that area and visually compared the changes of the area over time. Specifically we looked at whether the size of the grasslands increased or decreased, what species of tree was involved (deciduous or coniferous), and what the pattern of encroachment was.

Table 15. Airphotos used in the project

Year	Flight Line	Photos	Scale	Photo type	Comments
1947	A11798	53-58	1:40,000	Black and white	Part of area only this year
1949	A11930	217-221, 306-310	1:40,000	Black and white	Part of area only this year
1971	15BC5427	13-18, 47-50, 69-70	1:31,680	Black and white	
1971	15BC5425	231-235	1:31,680	Black and white	
2005		Orthophoto	1:20,000	Colour	

We did not produce digital overlays of the areas, as budget constraints did not allow for the costs involved in this process. The quality of the older airphotos was not as high as the later photos, leading to some difficulties in interpretation.

4.2 First Nations

All seven First Nations whose traditional territories included all or portions of Uncha Mountain Red Hills Park were contacted about the project by phone twice and by letter. Included with the letter were a copy of the Management Direction Statement and a draft of this report. The correspondence with First Nations explained the purpose of the project, and indicated a willingness to meet to discuss their concerns about the area. Only the Office of the Wet’suwet’en responded to these contacts.

Discussions were held with the Office of the Wet'suwet'en about cultural and natural resources in the park. They indicated that we had identified all the cultural resources in the park that they were aware of, and that the plans for prescribed burns in the grassland areas were consistent with traditional practices. They also felt that the trails and cultural sites on the south end of Uncha creek might need special consideration, but that small prescribed burns may not affect their integrity.

4.3 Stakeholder Consultation

A letter providing background information and requesting input was sent to a list of stakeholders in the Uncha Mountain Red Hills Park area. Also included with the letter was a copy of the Management Direction Statement, a response form and return envelope. Written or verbal responses were obtained from fourteen residents or groups.

A short article on the project and the request for stakeholder feedback was also included in the Burns Lake paper - Lakes District News. In addition, phone calls were made to some stakeholders to discuss the project.

Most respondents felt it was important to manage the vegetation of the park, with the benefit to wildlife given by several people as the reason. Most respondents were also in favour of prescribed burning. Prescribed fire was thought to be beneficial to wildlife, especially in the Red Hills where deciduous vegetation has matured and is no longer palatable. Prescribed fire was generally not thought to be required in response to MPB. Concerns about prescribed fire were smoke and fire spreading to residential areas. Natural processes were favoured, but there was some concern about fuel build-up and the potential for uncontrolled natural fire.

Responses to the option of killing selected trees by girdling or cutting small trees was mixed, with people not always sure of the benefit, wanting dense stands for furbearers, concerned about aspen suckering, and the potential for trail construction and ATVs using these new trails. If these potential negative effects were dealt with there seemed to be some support for tree management.

Concerns about potential impacts to values to adjacent lands from management actions in the park were about prescribed or natural fire escaping the park, smoke from prescribed fire, and additional access creation.

5 Managing Forests and Mountain Pine Beetles

5.1 Mountain Pine Beetle Ecology

Information in this section has been summarized from Safranyik and Carroll (2006) and Taylor *et al*. (2006).

The mountain pine beetle (MPB) is native to western North America with its range extending from northern Mexico in the south to northwestern British Columbia in the north, and from the Pacific coast in the west to South Dakota in the east. The main host tree species are lodgepole pine, ponderosa pine and western white pine; however, all native pine species and some exotic pine species are susceptible to attack.

Mountain pine beetle preferentially attack mature, large diameter pine trees, where a thicker phloem provides adequate resources for brood production. Adults generally emerge from attacked trees from late July to mid August to attack new host trees. Females lay eggs in galleries just beneath the bark, where larvae feed on phloem tissue. Eggs are the least cold-tolerant life stage of the MPB while the larval stage is most cold tolerant, able to sustain temperatures down to almost –40 C. Cold tolerance is greatest between December and February. Cold temperature is often the largest single source of mortality; however, other mortality factors such as predators, parasites, and interspecific competition could also have an influence when MPB population levels are low.

Trees are killed by a combination of larval foraging and introduction of blue stain fungi. Blue stain fungi penetrate the phloem and xylem, causing desiccation and interruption of transpiration. Trees die due to loss of moisture with needles fading from green to yellow in late May to early June the year following attack. Needles turn red by late summer of the year following attack and red needles may persist on trees up to 3 to 5 years following attack.

The population cycle of MPB has four phases: endemic, incipient-epidemic, epidemic (i.e. outbreak) and post-epidemic (i.e. declining) populations. During the endemic phase, MPB populations area very low, and beetles can only successfully attack trees with low vigour. If a beetle population increases it enters the incipient-epidemic phase. The main factors that permit the populations to escape the endemic phase are a decline in host resistance combined with favourable conditions for beetle establishment and survival. Climatic conditions such as a period of drought, or forest stand conditions such as of senility, disease or damage, could be the cause of decreased tree resistance.

Epidemic populations arise from conditions that result from the growth and expansion of local incipient-epidemic populations combined with long-range dispersal. Outbreaks may spread over thousands of hectares if large areas with a susceptible host, coincide with sustained favourable weather conditions for beetle establishment, development, and survival. Epidemic populations will collapse either due to a period of very cold weather in the late fall or early spring, or when susceptible hosts are no longer left on the landscape.

Post-epidemic populations will affect the landscape differently depending on the cause of the decline. When cold weather is the cause of the decline, beetles will continue to attack a similar tree profile to those that were attacked during the epidemic, but the lower number of beetles may mean that many trees are only partially attacked. However, if the decline is due to a lack of suitable host trees, the beetles will be forced to attack trees with reduced nutritional quality, or increased resistance, which will result in higher mortality than during the epidemic phase.

5.2 Epidemic History within the Park

Mountain pine beetle was first detected in low densities in the park in the mid-1980s before the area was a park. Control measures were undertaken at this time and mostly consisted of fall and burn treatments. In the mid-1990s the population of MPB started to expand. The fall and burn program continued until 2004 when the beetle population was beyond control. In 1999-2000 nine hundred trees were treated; 950 trees were treated in 2000-2001, and 1700 trees were treated in 2001-2002 (Blackwell and Steele 2002). The MPB population peaked in the park in 2003 and 2004, with the greatest density of trees with red foliage detected in 2005[2] (Map 7). Pheromone baits were also used in the park in later stages of control attempts.

Most of the forests with extreme or high susceptibility to MPB attack are in the Uncha Mountain portion of the park, concentrated in the north slopes and summit of Uncha Mountain and on the upper slopes of north-facing slopes at the east end of this portion. Concentrations of extreme and high susceptibility are also located on the eastern and western ends of the Red Hills portion (Blackwell and Steele 2002). Most areas of severe and very severe attack (Map 7) correspond to areas of high susceptibility, though to top the Uncha Mountain was not given a susceptibility rating but had severe MPB attack.

Mountain pine beetle surveys show that the peak of the epidemic was in 2004, with red attack detected in 2005 when the majority of the very severe and severe attack was detected (Table 16). Aerial photos taken in September 2006 show some of the areas with red foliage (Figure 5). Attack severity mapping indicates that virtually the entire park has been attacked by MPB; however, the detail of the mapping was likely not fine enough to show areas that were not attacked such as aspen and Douglas-fir stands.

Table 16. History of area (ha) attacked by mountain pine beetle at different levels of severity

Year	Trace	Light	Medium	Severe	Very Severe	Totals
2003	N/A[a]	2,663	264	34		2,961
2004	3,800	2,934	212	0	0	6,945
2005	738	370	980	1,412	1,038	4,538
2006	0	4,383	4,050	179	0	8,612

a – survey methodology changed between years

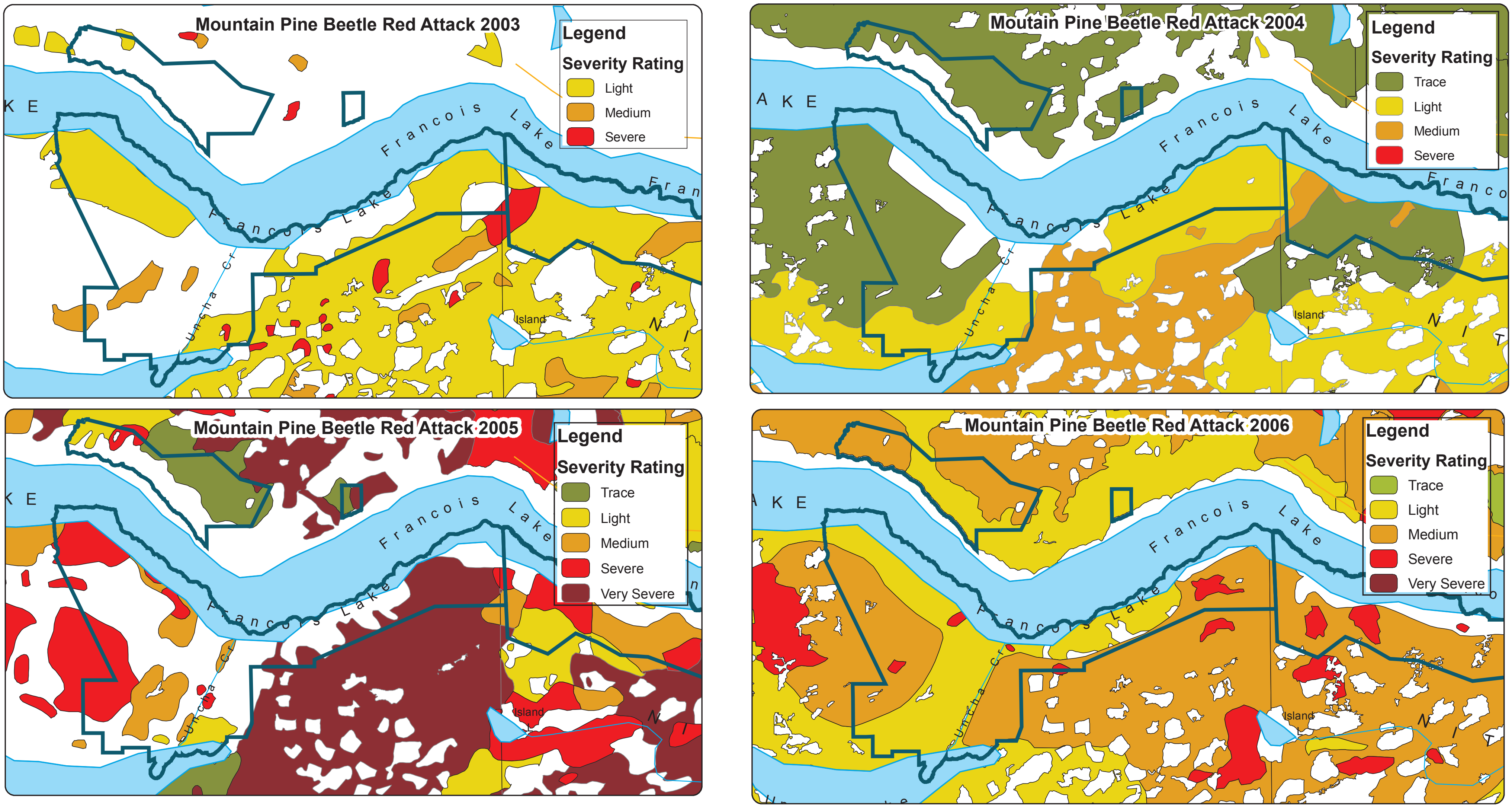
5.3 Effects of Mountain Pine Beetle

5.3.1 Mountain Pine Beetle, Forests and Wildlife

Mountain pine beetle primarily affects wildlife through indirect processes. The only direct effect is the dramatic change in food supply for those species that utilize MPB as a food source; all other effects are caused by changes to habitat resulting from the death of trees (Table 17). The importance of these effects and nature of these effects will be mediated through a number of factors (Table 18) (Chan-McLeod 2006). One effect not addressed by Chan-McLeod (2006), is the loss of canopy snow interception once needles drop, and resulting changes in show depths and conditions on winter ranges.

[2] Ratings shown on maps based on total stems of all species, excluding grey attack

Map 7 - Mountain Pine Beetle Red Attack History From 2003 to 2006



Eclipse GIS
February 3, 2007

Source: Pest Infestation Database - LRDW
WHSE_FOREST_VEGETATION.PEST_INFESTATION_POLY

0 2.5 5 10 Kilometers

Figure 5. Aerial views of mountain pine beetle attack in Uncha Mountain Red Hills Park, Red Hills (top), northeast Uncha Mountain (middle), and north slopes of Uncha Mountain (bottom)

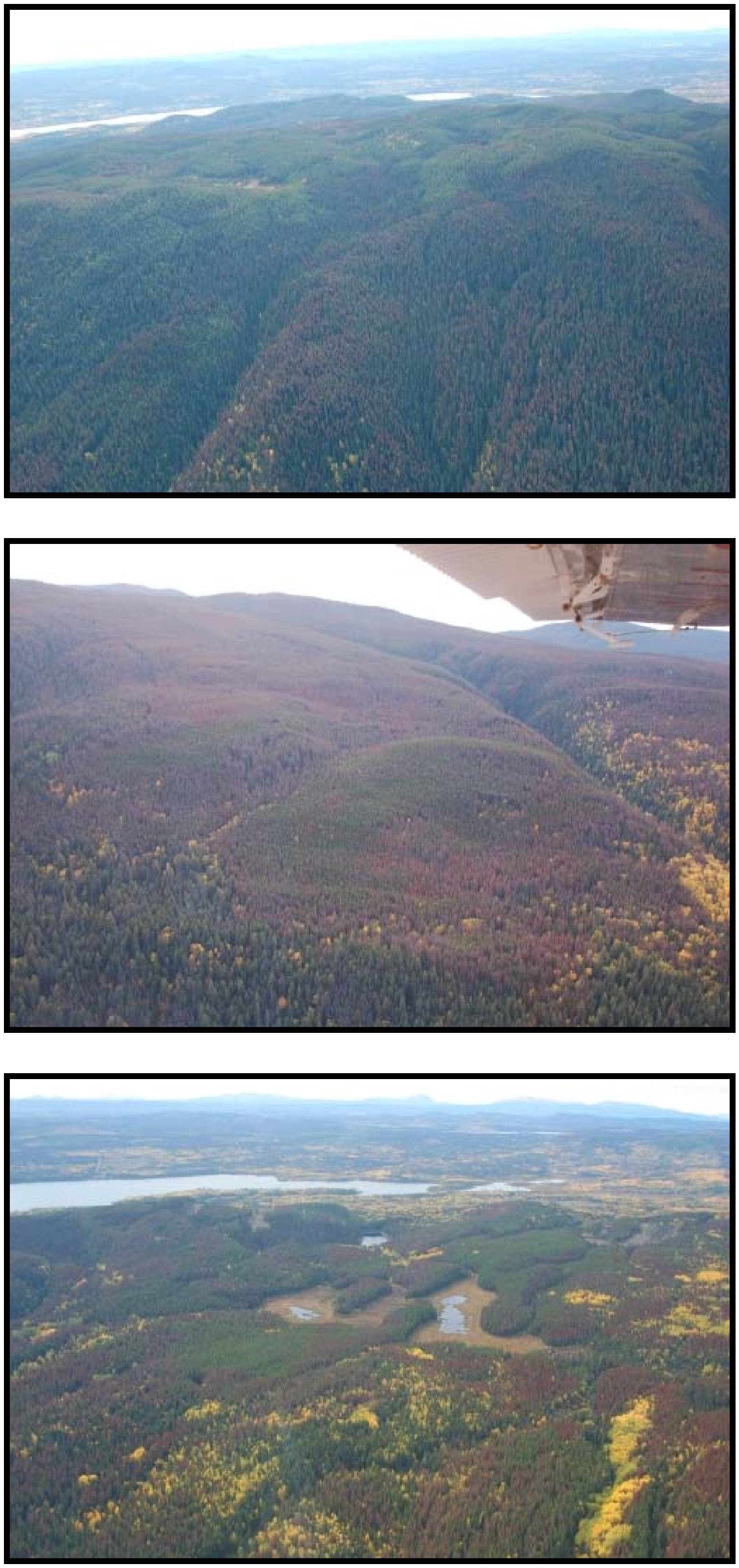


Figure 5 con't. Aerial views of mountain pine beetle attack on Uncha Mountain Red Hills Park, upper slopes of Uncha Mountain (top and middle), south of Uncha mountain towards Uncha Lake (bottom)

Table 17. Effects on wildlife of mountain pine beetle[a]

Process	Effect on Wildlife	Species or Species Groups Affected
Source of food	A number of bird species use MPB larvae and adults as food. Populations may respond by increased productivity and hence population size due to increased food availability. Populations will decline after epidemic subsides.	woodpeckers, brown creeper, red-breasted nuthatch, olive-sided flycatcher
Canopy defoliation	Canopy is important because: 1) needles are a food source, 2) invertebrates, which are used as a food source, live on needles, 3) resting or nesting habitat in canopy, and 4) shelter provided by canopy from weather, and cover for hiding, escape and hunting.	1) snowshoe hare, blue grouse, spruce grouse 2) foliage gleaners, including chickadees, kinglets, vireos, crossbills, warblers 3) various birds (e.g. northern goshawk [Mahon and Doyle 2003]) and mammals 4) various birds and mammals, especially ungulates
Loss of live bark	1) bark is used as a food source 2) bark harbours invertebrates that are a food source, but degree of negative effect may not be significant	1) voles, porcupine, moose 2) bark-gleaning birds such as nuthatches, woodpeckers, sapsuckers, brown creeper
Cessation of cone production	Pine seeds are used as a food source	Affected species include crossbills, voles, red squirrel and flying squirrel.
Increase in the number of standing dead trees (snags)	Snags are used for nesting, roosting, denning, perching and foraging. But lodgepole pine are not preferred snags and too many may be available to be used.	Mostly cavity-nesting birds and mammals, but also animals that glean invertebrates from decaying wood.
Fall of dead trees (increase in Coarse Woody Debris (CWD))	CWD is used in many ways by wildlife, including: 1) perches or cover, 2) burrowing habitat, 3) moisture retention and microhabitat provision, 4) travel corridors, and 5) invertebrates, which are used as a food source, live in CWD CWD may also hinder travel by some wildlife in high densities	A wide variety of small birds and mammals use CWD. Ungulates such as moose, deer and caribou
Increased understory production, especially shrubs	1) shrubs can provide food from its berries, foliage, seeds, and associated ectomycorrhizal fungi and insects 2) shrubs can provide cover/ nesting habitat	1) mammals including shrews, voles, mice, snowshoe hare, ungulates 2) understory nesting birds, marten

a – summarized from a review by Chan-McLeod (2006)

Table 18. Factors influencing on the magnitude and nature of the effects of mountain pine beetle on wildlife[a]

Factor	Effect
Time since death	The influence of different processes and the strength of the effects of MPB will change over time as regeneration grows and dead trees fall over and decay. As dead trees fall, wildlife that prefers open conditions or CWD will benefit.
Residual green component	Habitat values following the MPB epidemic will be high in 1) uneven aged stands where young trees were not attacked, 2) mixed species stands with live, mature non-pine species, 3) stands with a well-established shrub layer. The response of advance regeneration to the changed environmental conditions will vary greatly between tree species, and the health, size, density and spatial arrangement of the trees (Griesbauer and Green 2006).
Ecosystem type	1) Ecosystems will have different wildlife values before mountain pine beetle attack, stands with high wildlife values will continue to have high values; the converse is true for stands with low wildlife values. 2) Ecosystems will vary in their ability to respond to the changed conditions after the MPB epidemic. For example, soil moisture conditions may limit the response of shrubs and advance regeneration to increased light availability. 3) The benefits of snags may not be attained where they fall over early, such as in areas exposed to high winds, or high soil moisture.
Landscape effects	1) The effects of the MPB epidemic on wildlife will be lower in landscapes where pine is a small component of the forest cover, or attack is localized. 2) The negative effects of the MPB epidemic will be greatest in landscapes with extensive areas of dead pine trees.

a – summarized from a review by Chan-McLeod (2006)

Mountain pine beetle attack can produce young seral stands different from fire or harvesting initiated stands. Young seral stands created by MPB have a legacy of structural attributes, such as dead standing trees, as well as a remaining residual live component. Across the Sub-Boreal Spruce Zone, 40 to 50% of pine-leading stands have over 1000 stems per hectare of canopy and advance regeneration trees that will remain after the pine component has been killed (Coates *et al.* 2006). These stands have been called "young, wild stands" to distinguish them from young managed stands (Stadt 2002), and may provide more wildlife habitat than stands developed after fire or forest harvesting (Forest Practices Board 2007).

The legacy of structural attributes will have a lasting effect on stand function and structure for an extended period of time (Dykstra and Braumandl 2006), and will contribute to ecological processes, wildlife habitat, visual quality and hydrologic recovery of the forest (Coates *et al.* 2006, Forest Practices Board 2007). For example, stand disturbed by MPB 65 years ago were found to have more young regeneration and coarse woody debris than undisturbed stands and stands disturbed 25 years ago; the undisturbed stands had the most live basal area of the 3 stand types; and, the stands disturbed 25 years ago had the most vegetation volume, mostly as shrubs (Dykstra and Braumandl 2006). These results indicate an initial growth response by understory vegetation to tree death, whereas regeneration and CWD take longer to respond or build-up. The end result was an increase in stand and landscape heterogeneity.

A panel of ecologists providing input into the Lakes South SRMP recommended that managers avoid creating disturbances that are additive to the current MPB disturbance, and that the number of live trees removed or destroyed be minimized at both the stand and landscape level (Stadt 2002). Prescribed fire will be additive to the current MPB disturbance by killing advance regeneration, as well as adding to the lodgepole pine component on the landbase. A prescribed burn would remove these trees and further affect the function of forests in the park. Prescribed fire will not likely produce large enough habitat benefits to any species or species guild in MPB affected areas to make burning a priority.

When considering using prescribed fire, one must compare the composition and successional pathway of the present stand to that of the likely resulting stand. The successional pathway of the present stand will vary depending on species composition, seed availability, understory competition, stand density, light availability and seedbeds (Kimmins *et al.* 2005). Advance regeneration in pine stands in the SBS is composed of a mix of interior spruce, pine, black spruce and subalpine fir (Coates *et al.* 2006), whereas fire origin stands are dominated by lodgepole pine (Shore *et al.* 2006).

Uncha Mountain Red Hills Park, which has mixed species stands and stands with a range of age classes, will have relatively high value wildlife habitat. The existing high wildlife habitat values will continue to exist because of the diversity of forest types found within the park. Over time, the species that benefit from, or are detrimentally affected by, the resulting ecosystem process will change. But, the lack large areas with pure pine stands in Uncha Mountain Red Hills Park indicates that the wildlife in the park will experience fewer detrimental effects than other areas.

Ungulates

Effects of MPBs on ungulates will depend on the extent of MPB attack across the landscape and the proportion of affected trees in each stand. Most of the areas attacked in the park were rated trace, light, or medium (Table 16). Most of the severe and very severe MPB attack was located in eastern areas of the Uncha Mountain Portion and at higher elevations on Uncha Mountain, which are either not considered ungulate winter range, or are ranked high value moose winter range (Map 5 and Map 7).

Mountain pine beetle attack in high value habitat could result in potential positive and negative effects on ungulates. Increased abundance of favoured shrubs, herbs and grasses following MPB attack could benefit moose and mule deer. Stone (1995) found that moose and mule deer fecal pellet counts increased with the percentage of tree mortality in lodgepole pine stands in Utah following MPB mortality; however, he did not distinguish between winter and summer pellet groups so it is unclear whether increased use occurred in winter or summer or both.

Ungulate movements could be affected by MPB attack through: loss of canopy snow interception resulting in increased snow depths or altered snow conditions; and/or, accumulation of coarse woody debris once beetle-killed trees fall over impeding travel. Changes to snow depth/conditions will affect winter habitat, while increased accumulation of coarse woody debris will affect both summer and winter habitat. Factors affecting ungulate movements (altered snow depth/conditions, coarse woody debris) could also affect predator movements. This could result in either positive (ungulate movements less affected by obstructions than predator movements) or negative (ungulate movement more affected by obstructions than predator movements) effects on ungulate populations.

For mule deer, most of the area affected by MPB in Uncha Mountain Red Hills Park is summer habitat on the upper slopes and slope crests, with the winter range on the mid to lower slopes; the MPB epidemic, at its current extent, could potentially positively affect mule deer through increased summer forage abundance.

For moose, much of the area affected by MPB is summer habitat, but some winter habitat is also affected. At its current extent, the MPB epidemic in Uncha Mountain Red Hills Park will likely have little if any impact on moose, and, like for mule deer, could result in potentially increased forage abundance in some limited areas.

Other Mammals

Marten are one of the most important fur-bearers in the Skeena Region. Marten are sensitive to the structural composition of forests; they particularly favour forests with abundant coarse woody debris (CWD), such as downed logs and stumps, and a mixed canopy of shrubs, saplings and trees (Banner *et al.* 1993).

Forests that have been attacked by MPB will provide abundant CWD as the dead trees topple over time. In areas with pure stands of pine, there may not be sufficient trees remaining to provide the tree canopy component required. However, in Uncha Mountain Red Hills Park, forests are mostly mixed, so this may not be a problem. Prescribed fire will remove CWD by burning, and will also kill non-pine trees in burnt areas. Removal of CWD and killing of live trees will be detrimental to marten habitat.

The effect of MPB on red squirrels and flying squirrels may be minimal. Populations will likely begin to decline about 10 years after tree death, but will have a fairly rapid recovery as a new forest gets established (Steventon 2006).

Cavity-nesting Birds

The effects of MPB on bird communities are not fully understood, but research is starting to shed some light on the issue. One of the most important guilds of forest dependent birds is the cavity nesting guild. These birds can be divided into three groups: primary cavity nesters, who excavate their own cavities; secondary cavity nesters, who use cavities made by other animals; and small cavity nesters, who make their own cavities or use existing cavities. Secondary cavity nesters also include bats and squirrels.

Lodgepole pine is not a preferred tree for nesting sites of cavity-nesting birds (Bunnell *et al.* 2004). The abundance of cavity nesting birds may initially increase due to MPB, but will likely decrease as the food supply decreases in later stages of the epidemic (Martin *et al.* 2006). The post-epidemic stage, and the amount of available habitat, are of most concern over the long-term.

The habitat needs of cavity nesting of birds can be varied. For example, most of the woodpeckers, nuthatches and chickadees in this guild tend to nest in aspen trees but feed on invertebrates that live in conifer trees (Martin *et al.* 2006). Most research on habitat supply in a post-MPB landscape is focussed on harvested landscapes, not on the unharvested landscapes found in protected areas. Martin *et al.* (2006) recommends that habitat management include:

1. retention of all deciduous trees, especially those near conifers,
2. retention patches $\geq$1 ha, with some larger patches (>10-50 ha) for mature-forest-dependent species, and
3. retention of riparian areas and other conifer forests for wildlife refuges.

Fish

Fish may be affected by MPB if riparian forests contain a large pine component that is killed by MPB. One concern surrounds the potential for increased water temperatures resulting from the reduced shading capacity of the surrounding forests if the pine component dies (Wilford and Sakals 2005). Other potential effects of MPB include changes to the nutrient status of waters due to reduced nutrient uptake by the trees, and changes to the timing and size of water flows due to hydrological changes resulting from decreased transpiration and canopy rainfall interception; these effects are beyond the scope of this project.

Uncha Creek is the only fish-bearing waterway in Uncha Mountain Red Hills Park. Because the forests surrounding Uncha Creek are dominated by aspen and interior spruce with pine being a minor species near the creek (Figure 6, Map 3). MPB will likely have a negligible effect on fish-bearing capacity of the creek.

Figure 6. Overview of the forests surrounding Uncha Creek, looking north

5.3.2 Cultural Values

The impacts to cultural values by MPB are not likely to be great as there is no cultural infrastructure other than historical trails, and these are not maintained. In the event of a forest fire, fire fighting activities such as fire breaks will need to consider the location of culturally significant sites.

5.3.3 Recreation Values

The impact of MPB on recreational values and activities are diverse and in some respects will vary with the values or perspective of the individual. One of the concerns in the park is the risk posed by large numbers of dead trees in areas used for recreation. One aspect of managing this risk is knowing how long dead trees are likely to stand before falling over.

The Forest Practices Board (2007) found that 55% of dead trees had fallen 25 years after MPB attack in the Sub-Boreal Pine Spruce (SBPS) zone, an area drier than the park. Predictions for the drier part of the Sub-Boreal Spruce zone are that 25-50% of attacked trees will have fallen ten years after they are attacked. Soil moisture content appears to be the most important factor in determining the rate of tree fall, with trees in wetter areas decaying and falling the fastest (Lewis and Hartley 2005).

Management activities that could reduce the risk to recreational users include falling dead trees and moving recreational infrastructure to areas without dead pine trees. In Uncha Mountain Red Hills Park where recreational infrastructure is limited to trails with low levels of use, management activities may consist of removing dead trees from congregation areas such as parking lots, and removing dead trees from trails after they have fallen. Rerouting trails around areas of attack is not necessary in this park since the main trial, the Red Hills trail, is located in an area with only a minor component of pine. The only known parking area regularly used by park visitors is that at the trailhead on the western boundary of the Red Hills area.

Trails in the park could also potentially become wetter in MPB killed stands. Due to expected rises in water tables due to reduced evapotranspiration and reduced interception of precipitation by the canopy (Rex and Dubé 2006).

Two trapping cabins are located in the park, these may be located near attacked pine stands. However, responsibility for the maintenance of these cabins is with the cabin owner and not with BC Parks, though BC Parks would work to protect these cabins from wildfire.

5.4 Restoration after Mountain Pine Beetle

5.4.1 Options

There are two practical options for managing values following the MPB epidemic: prescribed burning, and allowing natural processes proceed. Allowing natural processes to proceed is the default option and includes succession and natural fire. The main reasons to proceed with prescribed fire would be:

1. if the successional trajectory of the vegetation post-MPB, including the dead component, was projected to produce negative effects to desired vegetation or wildlife in the park, and if these negative effects outweighed any positive effects and could be corrected by fire, or
2. if the natural fire risk to natural or cultural values either inside or outside the park was high enough to warrant intervention to prevent a large-scale wildfire.

5.4.2 Needs

As detailed in the study area description section, the forests of Uncha Mountain Red Hills Park are mostly mixed species stands with few areas containing pure stands of pine, (though 71% of the forests in the park have a pine component). This indicates a substantial live component will remain in the canopy in a post-MPB landscape. Most pine stands also contain a considerable advance regeneration component.

The mixed forests of the park also mean that the impacts to wildlife will not be as great as in pure pine areas. One of the main concerns to wildlife is that the fall of dead trees will create mobility problems for large ungulates (Gawalko 2004). Prescribed fire may remove some dead trees from the forest, but may not solve mobility concerns. As time since tree death progresses, the suite of species that benefit from or are negatively impacted by the changes to the forest by MPB will change, but there is not a large negative impact to any single species or group of species that can be corrected by prescribed burning.

Forests <40 years old are lacking in the park. The MPB epidemic will result in younger forests, as the beetle will kill older pine trees, and release young understory trees resulting in stands that reflect the mix of tree species on the landscape, especially in the advance regeneration component. Prescribed fire will also produce young forests, albeit slightly younger pine-dominated stands. Both processes will produce the younger forests that are presently lacking in the park.

Pure pine forests may also be lacking on a post-MPB landscape, so there would be some value in prescribed fire in producing younger forests and pine forests. The question is whether Uncha Mountain Red Hills Park is the right place for this to occur. With the mix of forest types, presence of residences and concerns over smoke, a more remote park may be more appropriate for this type of management.

The changes in fuel types that will occur due to the MPB epidemic will increase the fuel hazard; however, fuel characteristics and fire potential within the park is not higher than that of the surrounding landscape. The fire behaviour potential in developed surrounding areas is lower than that in the park, and the number of days when continuous crown fire is possible is low. This all reduces the need for prescribed fire in the park to reduce fuel loading and fire potential.

5.5 Rehabilitation Prescription

We recommend that natural processes such as succession and natural fire be allowed to proceed in the forests of Uncha Mountain Red Hills Park in a post-MPB landscape, and that prescribed fire not be used in the park to respond to the MPB disturbance.

A number of factors have been taken into account, as detailed in earlier sections, in the making this decision, including:

1. the mixed tree species composition of most of the forests of the park,
2. the lack of clear gain to park values, especially wildlife, by the effects of prescribed fire,
3. the likely presence of a substantial component of understory regeneration in the forests in the park,
4. the need to avoid further disturbance on the landscape post-MPB,
5. the fuel characteristics in developed areas surrounding the park are generally less hazardous than those in the park, and
6. the number of days when continuous crown fires would be possible are few.

In the fire plan for the Uncha Mountain Red Hills Park, the entire park is zoned as a Modified Protection Zone where initial attack may be conducted on all fires. The plan does not, however, give detail of what will be considered when determining whether to attack a fire or not. More detail on this in the fire plan would guide managers when decisions are being made on whether suppression is needed.

A lack of natural fires in the park indicates that natural fires should be allowed to burn as much as possible. This is consistent with BC Parks policy of allowing natural processes to occur in parks, as long as life and property are protected. The less flammable fuel types in adjacent areas limits the potential for fire to spread to adjacent areas.

6 Managing Grasslands

6.1 Grasslands in west-central British Columbia

Natural grasslands in west-central British Columbia occur mainly in the SBSdk (dry cool) and SBSmc2 (moist cold, Babine variant) subzones of the Sub-Boreal Spruce (SBS) Biogeoclimatic (BEC) zone, and in the Bulkley Basin Ecosection. Grasslands in these two BEC subzones make up 95% of the total grassland area in the southern portion of the Skeena Region (Grasslands Conservation Council of BC 2004).

A provincial grassland mapping project, which in the Skeena Region was based on open range polygons in forest cover maps, found that the majority of grasslands occur within the Bulkley Basin Ecosection (85% or 15,581 ha) and in the SBSdk BEC subzone (12,692 ha or 69%). The grasslands in Uncha Mountain Red Hills Park occur within the Bulkley Basin Ecosection and the SBSdk BEC subzone. Inaccuracies in using open range polygons to map grasslands are due to some areas are agricultural clearings, wet meadows, or are forested, while some grasslands are not typed as open range. The net result is a likely over estimation of grassland area in the region. The area of grassland in the Skeena Region is 2.4% of the provincial grassland total (Grassland Conservation Council of BC 2004). In the SBSdk, only two types of grasslands have been formally described, the Saskatoon-Slender wheatgrass scrub/steppe (SBSdk/81) and the Bluegrass-Slender wheatgrass grasslands (SBSdk/82).

6.1.1 SBSdk/81

The SBSdk/81 (Saskatoon – Slender wheatgrass scrub steppe), is Red-listed (S2) by the BC Conservation Data Centre. It occurs on steep (20-80% slope) dry rocky sites with warm aspects and base rich parent materials, and are too dry to support large trees; the sites are a mosaic of scrub and steppe grasslands. This is likely the dominant grassland type in Uncha Mountain Red Hills Park and in the region.

Haeussler (1998) proposed that the SBSdk/81 be split into two phases, a shallow soil phase (81a) that occurs on morainal and colluvial veneers, with frequent bedrock outcrops, and a deep soil phase (81b) that occurs on steep erosional scarps formed in unconsolidated lacustrine, fluvial or morainal deposits. Haeussler (1998) found the deep soil phase to be much less common that the shallow soil phase in the Prince Rupert Forest Region.

Haeussler (1998) further proposed that the SBSdk/81 be divided into two variants based on the presence (>5% cover) or absence (<5% cover) of Rocky Mountain juniper. The Rocky Mountain juniper variant was found to be much less common than the variant without Rocky Mountain juniper in the Prince Rupert Forest Region. Some of the occurrences in the Red Hills area contain Rocky Mountain juniper (A. de Groot *pers. obs.*).

The SBSdk/81 is important for wildlife, especially deer and garter snakes, due to the warm aspect and low snowpack. It may also support plant and insect species that are not found elsewhere on the landscape (Haeussler 1998).

The occurrences of SBSdk/81 on shallow rocky soils are thought to be relatively stable, and may only require intermittent fire (perhaps every 30 – 100 years) to prevent tree encroachment. Activities on these sites that lead to the exposure of mineral soils, such as sustained recreational use or heavy grazing, can facilitate the spread if invasive plant species (Haeussler 1998).

In the Euchiniko Sidehills area, 90 km southeast, the SBSdk/81 community is in excellent condition mostly due to its inaccessibility to cattle, being located on very steep upper slopes and rocky hillcrests (Simonar and Migabo 2004a). This contrasts with the occurrences in the former Bulkley Forest District, where most occurrences are threatened (Haeussler 1998).

6.1.2 SBSdk/82

The SBSdk/82 (Bluegrass – Slender wheatgrass), is Red-listed (S1) by the BC Conservation Data Centre, is not a well-defined plant community, and is the only non-wetland herb-dominated site formally recognized in the Skeena Region. This community occurs on fine loamy soils and on flatter terrain (0-30% slope) than the SBSdk/81, and is more of an open grassland than the SBSdk/81. The SBSdk/82 occurs on warm aspects; trees, shrubs and mosses are generally absent. This community has a well-developed and diverse herb layer with few shrubs. Most SBSdk/82 sites have now been converted to hay fields or pastures (Banner *et al.* 1993).

Because the SBSdk/82 is the only herb-dominated community formally described, any semi-permanent herb-dominated open site is lumped into this site series (Haeussler 1998). Inventories of herb-dominated meadows have shown that few sites actually fit the description of this site series. These meadows (see below) have been described in other unpublished reports (Oikos Ecological Services 1997, Haeussler 1998, Simonar and Migabo 2004a). The area of true SBSdk/82 is much less in the region than that of other herbaceous community types, especially the cow parsnip dominated community described by Haeussler (1998) and Oikos Ecological Services (1997).

6.1.3 Other Herbaceous Plant Communities

A number of different herbaceous plant communities, other than the SBSdk/81 and 82, some of which are graminoid-dominated, have been identified in the SBSdk subzone (Oikos Ecological Services 1997, Haeussler 1998, Simonar and Migabo 2004a), but these have not been formally recognized in the BEC system. Most of these communities would presently be placed under the SBSdk/82 unit in the present BEC classification, as they most resemble this community type over any other communities in the present BEC classification (Haeussler 1998, Simonar and Migabo 2004a). These communities are mostly located on warm aspect slopes on a variety of soils and moisture regimes.

Herbaceous plant communities that have been recognized in the SBSdk include:

- Aster – Meadow rue – Peavine – Fireweed
- Cow parsnip – Large-leaved avens
- Needlegrass – Slender wheatgrass
- Needlegrass – Timber oatgrass
- Pasture sage – Slender wheatgrass
- Pinegrass – Kinnikinnick
- Pumpelly brome – Peavine
- Timber oatgrass

Based on the wide variety of herbaceous plant communities found in the SBSdk, it is likely that a number of these communities are present in Uncha Mountain Red Hills Park. The scope of this project did not include completion of a vegetation inventory of the park to find out which communities are present.

6.2 Grassland - Aspen Dynamics

6.2.1 Invasion of Grasslands by Aspen

In west-central BC and the Peace River region of BC, aspen is the main tree species invading grasslands. This is different from most of southern British Columbia where conifer tree species such as Douglas-fir and pine are encroaching on grasslands (Veenstra and McLennan 2002, Grassland Conservation Council 2003). Grassland dynamics in the study area are complex and have many interacting biotic (herbivores and ants) and abiotic (geology, climate and fire) factors (Gayton 2003, Haeussler 2000). Wetter grasslands are likely more susceptible to encroachment than drier types (Holt 2001).

The area covered by grasslands has likely fluctuated over time as the balance between moisture and temperature, and consequently, fire has changed with climatic variation. Other factors such as the amount of grazing and browsing by ungulates such as bison and elk have been shown to be important in other areas (Campbell *et al.* 1994, Romme *et al.* 1995). The population of ungulates in British Columbia was likely too low to have been an important factor in grassland dynamics in this area (Gayton 2003). Little information is available on the influence of First Nations burning in maintaining the grasslands in Uncha Mountain Red Hills area, but in the Smithers – Hazelton area, First Nations burning has been significant (Johnson Gottesfeld 1994). Due to the long history of First Nations residence in the area, First Nations burning is considered a natural ecosystem process.

Aspen is adapted to recolonize sites following fire, even though it is intolerant of fire due to its thin bark. After the above-ground tree is killed by fire, aspen roots will produce many suckers for several years. Suckering, from carbohydrate storing lateral roots, is the main reproduction method for aspen. Aspen reproduction by seed is uncommon and of minor importance.

Disturbance to the tree by hailstorms, girdling, root or foliage damage, will also promote suckering (see review in Frey *et al.* 2003); some suckers may also be produced in undisturbed stands. The invasion of grasslands by aspen can be stimulated by disturbance to the existing trees in the area. This can include natural disturbances such as hailstorms, which have been shown to stimulate sucker production up to 10 m in the adjacent grassland (Peltzer and Wilson 2006). It is possible that the widespread damage to aspen caused by the early heavy snowfall in the Burns Lake area in October 2006 will initiate aspen suckering.

Suckers rely on carbohydrate reserves stored in the roots until they can start to produce their own carbohydrates through photosynthesis. The growth of suckers can be limited by the amount of carbohydrate reserves stored in the parent tree's root system (Frey *et al.* 2003).

The number of suckers produced after disturbance can be very high with up to 280,000 stems/ha being reported but 40,000 to 75,000 stems/ha reportedly being more common (Howard 1996). The number of suckers will decrease quickly through natural thinning, with most clumps being reduced to a single stem after 5-10 years. Fire severity can affect the density of suckers, but sucker mortality is closely related to sucker density. This differential mortality may result in stands of a similar density regardless of fire severity (Wang 2003).

In recent times, wildfires have been controlled on Crown Lands by the Ministry of Forests, Protection Branch to protect forest resources and development infrastructure. A consequence of fire control is that woody species, such as aspen, spruce and pine can become established in grassland areas where they otherwise may have been controlled by periodic burning.

6.2.2 Influence of Climate

Multiple climatic factors operating on different spatial and temporal scales could be influencing local vegetation dynamics. These include long-term climate change related to global warming, the Pacific Decadal Oscillation (PDO) and the El Nino-Southern Oscillation (ENSO). The climate of the Skeena Region has been wetter during the summer in recent years than over the long term average in the region (Figure 7) (Woods *et al.* 2005). Northwest BC is the only area that experienced an increase in summer precipitation during this period. This additional moisture may have facilitated the invasion of grasslands by woody species.

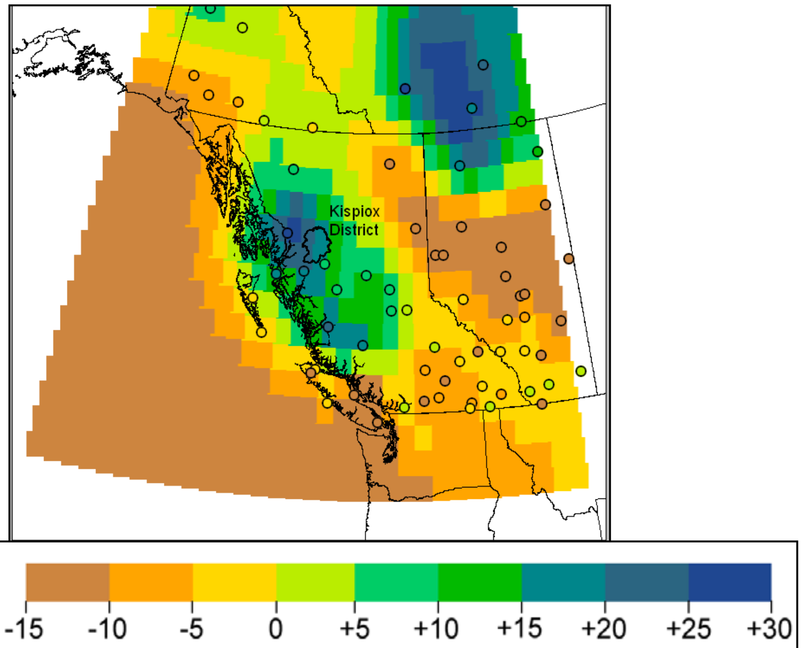


Figure 7. **Percent change in mean summer precipitation from 1960-1991 normal period to the 1998-2002 average across BC. (from Woods et al. 2005)**

The Pacific Decadal Oscillation represents the ocean temperature in the North Pacific, and is comparable to ENSO, but the climatic states persist for decades instead of months. Warm ocean temperatures associated with the positive phase of the Pacific Decadal Oscillation produces warmer, drier winters, while the negative phase associate with cooler ocean temperatures produces cooler, wetter winters. The effect of the Pacific Decadal Oscillation on summer weather conditions needs further research (Hessl *et al.* 2004). Some evidence is available that forest fire occurrence in Washington State is related to the Pacific Decadal Oscillation (Hessl *et al.* 2004). The warmer winter temperatures produced by climate change are partly responsible for the current MPB outbreak (Taylor *et al.* 2006).

Recent climate change modelling has looked at the influence of predicted climate change on the distribution of BEC zone and tree species in British Columbia (Hamann and Wang 2006). This has indicated that the area covered by the SBS zone will decrease by 13% by 2025. The climate of the Uncha Mountain Red Hills area is predicted to eventually (by 2085) become like that of the Interior Douglas-fir zone. If these predictions are correct, there will be implications on ecosystem dynamics and restoration efforts in the park.

These long-term climate patterns could also influence grassland restoration efforts (Hamann and Wang 2006) by either assisting efforts if the climate changes in a direction that limits the growth of woody species and increases fire frequency, or hinder efforts if the climate changes in a direction that facilitates woody species and decreases fire frequency. While these long-term climatic changes may not directly influence restoration activities in Uncha Mountain Red Hills Park, it is important to keep in mind possible influences on vegetation beyond the control of management activities.

6.3 Historical Airphoto Comparison

6.3.1 Red Hills Area

Area 1

This area is located at the eastern edge of the Red Hills (Map 2). The small rocky outcrop area at the centre of this grassland is still open; however, the areas surrounding this outcrop have been encroached upon by aspen trees to some extent (Figure 8). This area should not be a high priority as the core area is likely too rocky to support large trees, and thus will remain open.

Area 2

This area is located on steep southwest facing slopes immediately above François Lake (Figure 9). The 1948 photo shows open grassland areas with some small patches of trees within the grassland areas. By 1971, the clumps were starting to merge together and the smaller grassland areas were nearly taken over by trees. In 2005, the fingers of grassland near François Lake are mostly gone, though the larger open areas are still present but much smaller than in 1948.

Area 3

This group of grasslands is located on a series of rounded knolls above François Lake (Figure 10). In 1948, the 4 patches of grassland that are presently mapped in this area were set in a landscape that had much smaller deciduous vegetation and was much more open than the present day grasslands. By 1971, conifers were encroaching over much of the landscape, and aspen was developing into a tree layer. By 2005, the development of the conifer and aspen tree layer had greatly advanced, both the size of the trees and in the area that they covered. Conifers continued their establishment across the area and aspen continued to expand into open areas.

Area 4

Located on steep sloped above François Lake near the west end of the Red Hills (Figure 11). The quality of the 1948 image makes it difficult to determine the vegetation types at that time. However, comparisons of the 1971 and 2005 images clearly shows that open areas are decreasing in size. Deciduous species are expanding into open areas and conifers are expanding into deciduous areas. Clumps of deciduous trees are coalescing into larges patches. In addition to the mapped grasslands, there are additional open patches in the area that could be grasslands.

6.3.2 Shannon Property

In 1947, the Shannon Property was a mix of open grassland, low shrubs, and deciduous and coniferous forests (Figure 12). By 1971, the low shrub areas had grown into taller shrub communities, with many patches of tall shrubs, but still with a substantial open grassland component between tall shrub patches. By 2005, these tall shrub patches had expanded overtaking the smaller open patches that had existed between tall shrub patches. In 2005, only the three largest open grassland areas remain, but aspen has mostly colonized low shrub areas. The aspen that has colonized the low shrub area, may continue to spread and take over the remaining grassland area. The low shrub areas that existed in 1947 may have contained young aspen trees as this tree species presently dominates these areas.

6.3.3 Uncha Lake Area

Two areas of grassland are located in the Uncha Lake portion of the park. The largest is at the east end of Uncha Lake on south-facing slopes above the north shore. The second area includes some small patches in the extreme southwest corner of the park that are part of a larger group of grasslands located to the west outside of the park.

In 1948 on the area next to Uncha Lake, conifers were mostly restricted to northwest facing slopes (Figure 13). The warmer slopes were a mix of grasslands, and deciduous shrubs and forests. By 1971, the deciduous component had developed, with the aspen trees taller than in 1948, and there is also some evidence of conifers expanding into the deciduous dominated areas. In 1971, the warmest slopes were still open and appeared to be changing less than the deciduous areas. By 2005, the trend appear to be similar, in that the open areas appear to have changed little while more conifers are present in the formerly deciduous areas. Overall, grasslands appear to be maintaining themselves in this area, while the conifers are invading the deciduous stands.

The existing grasslands in the southwest corner of the park , labelled Uncha Hills, are different from other areas, in that they were more open in 2005 than in 1948 (Figure 14). The grasslands in the park are the two areas sloping from southwest to northeast in the centre of the photo, near the crest of southeast facing ridges. In 1948, the areas in the park were dominated by shrubby deciduous vegetation, unlike some open grasslands outside the park just to the south, and conifers were restricted to several dense patches. By 1971, the openings were clearly visible and looked similar to how they did in 2005. In 2005, the areas remained open, though the forests around them were developing and pine was becoming more prominent.

6.3.4 Summary

Overall, there has been a large increase in both deciduous and conifer tree cover throughout the park and a decrease in open grassland area. Areas with small, sparse conifers have increased in size and density. Many of these conifers are pine, which are now being killed by MPB. Areas with low shrub deciduous vegetation are now in aspen forests. Most of these changes likely are the result of succession after previous fires, as fire scars were found on trees at all locations visited, but no large fires have occurred since the 1949 airphotos were taken.

Figure 8. Red Hills grasslands area 1 aerial photos taken in 1949 (top), 1971 (middle) and 2005 (bottom).

Figure 9. Red Hills grasslands area 2 aerial photos taken in 1949 (top),1971 (middle) and 2005 (bottom)

Figure 10. Red Hills grasslands area 3 aerial photos taken in 1949 (top),1971 (middle) and 2005 (bottom)

Figure 11. Red Hills grasslands area 4 aerial photos taken in 1949 (top),1971 (middle), and 2005 (bottom)

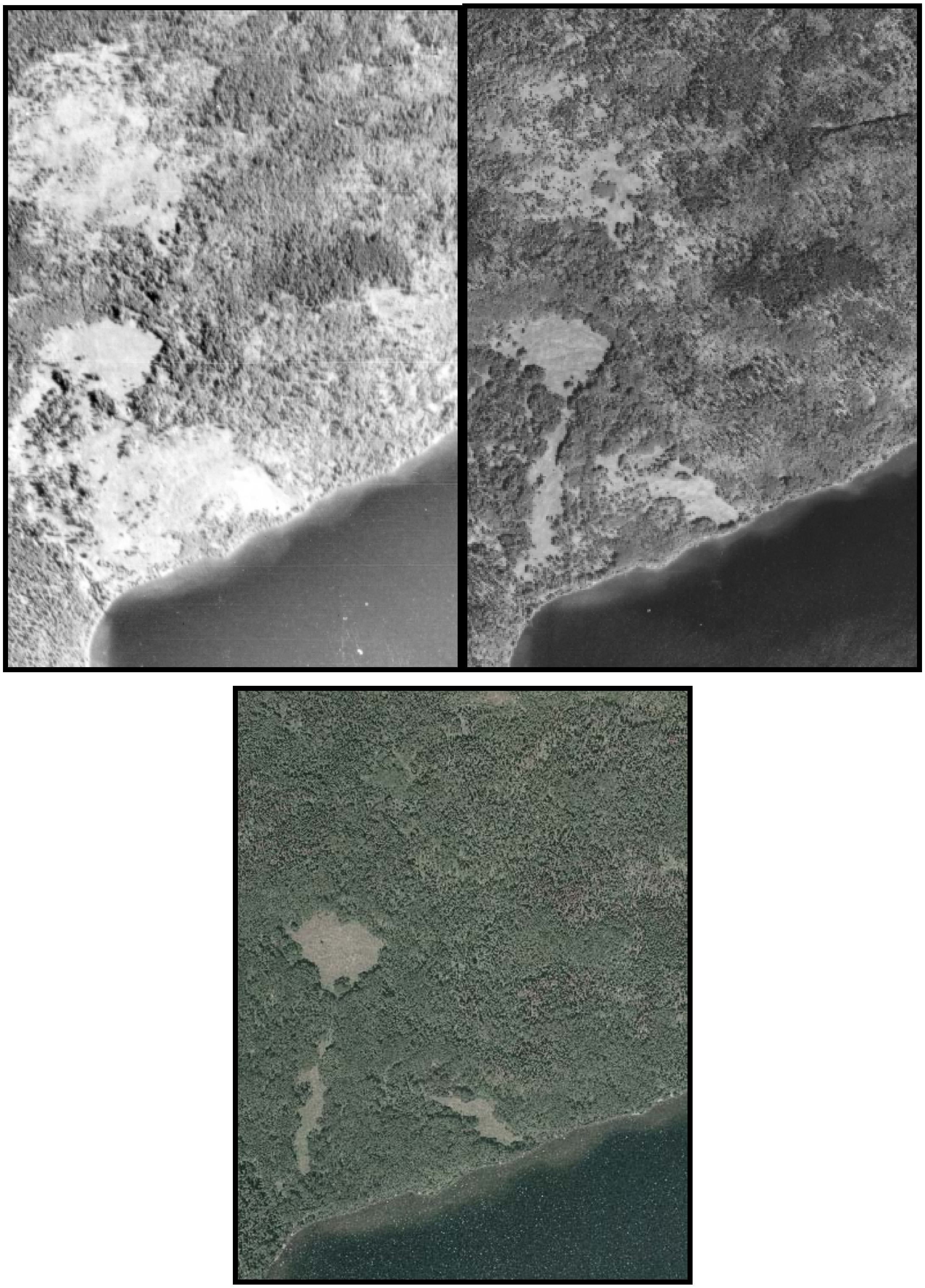


Figure 12. Shannon property grasslands aerial photos taken in 1947 (top left), 1971 (top right) and 2005 (bottom)

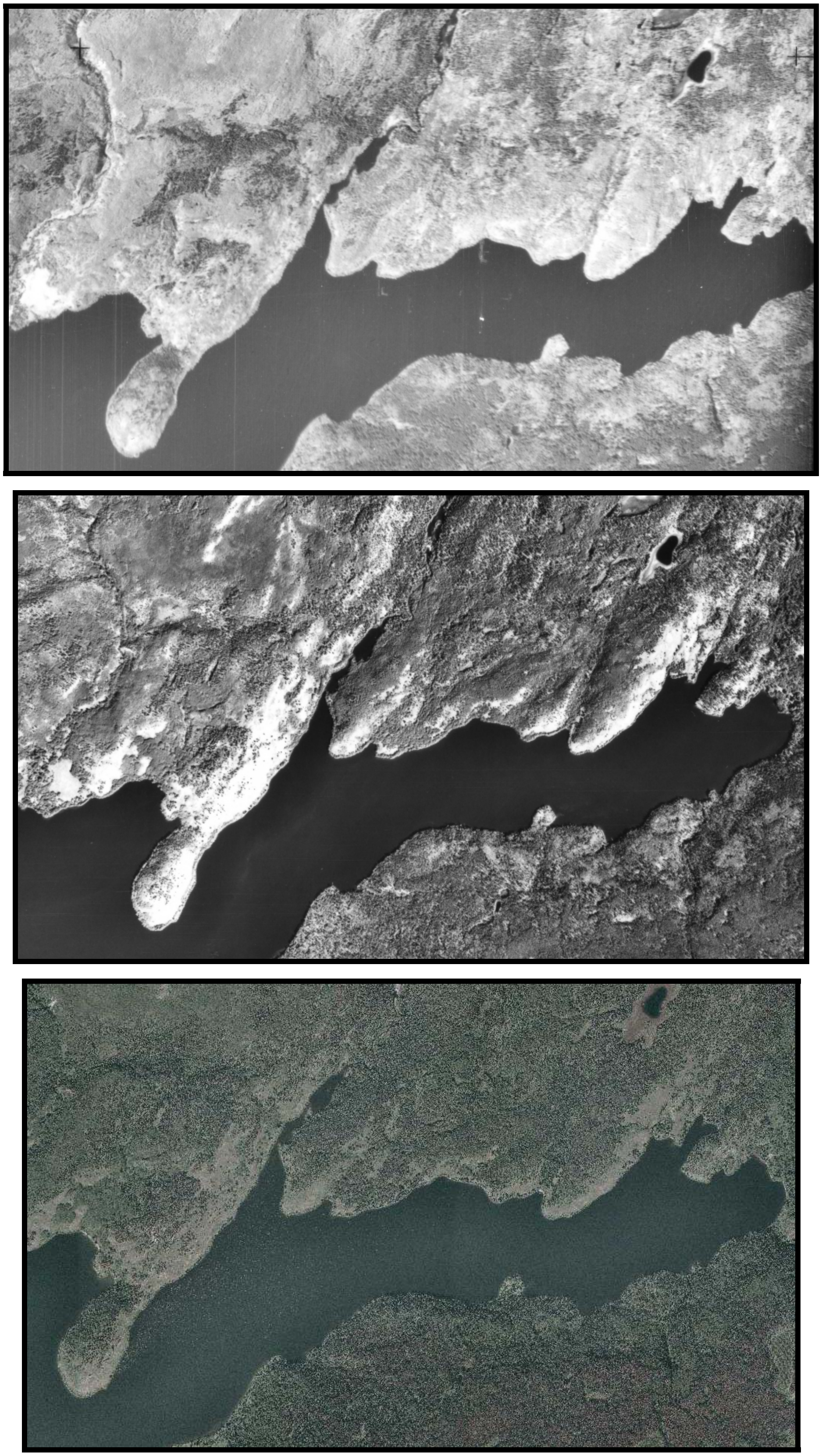


Figure 13. Uncha Lake grasslands aerial photos taken in 1949 (top),1971 (middle) and 2005 (bottom)

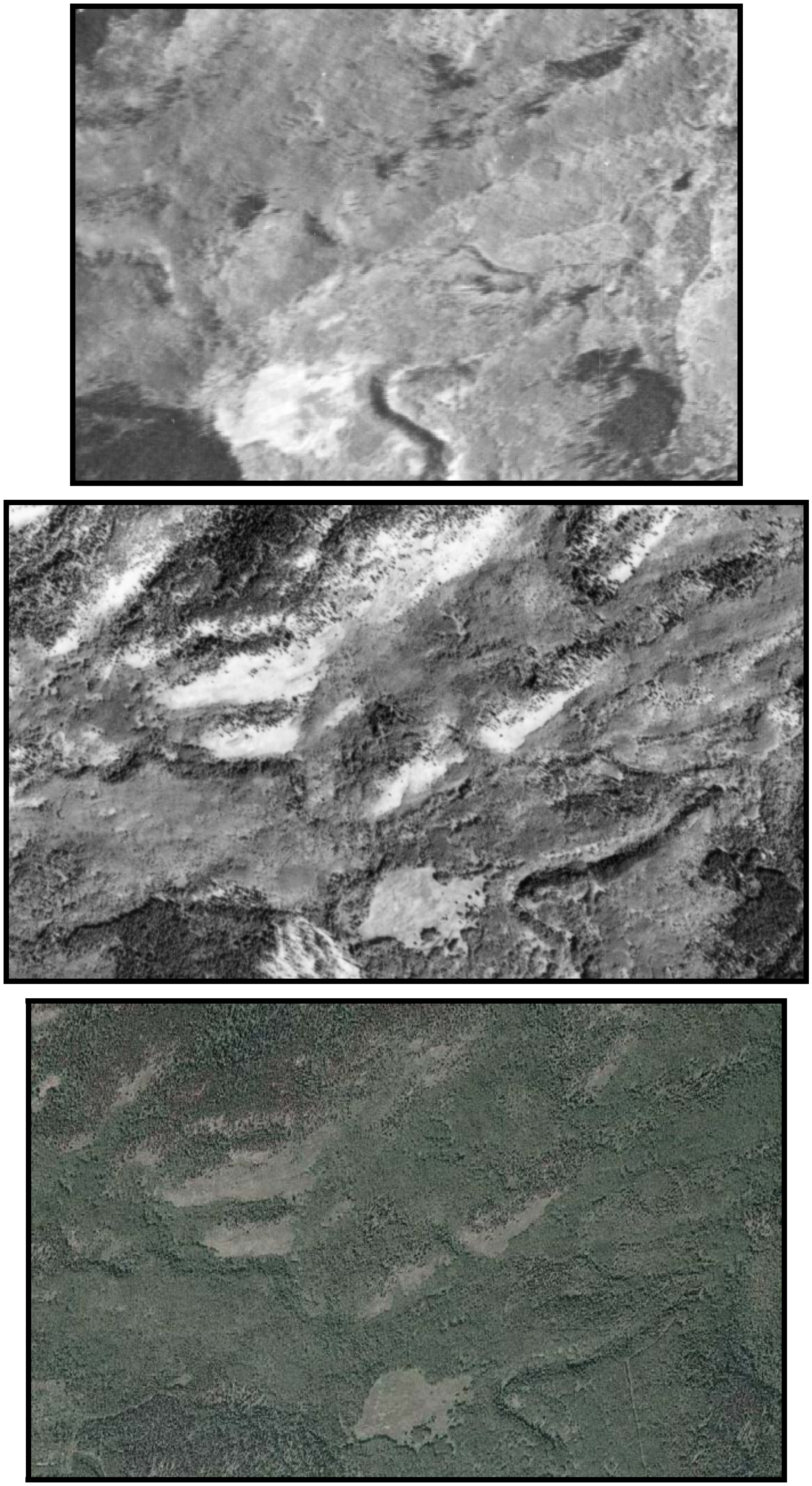


Figure 14. Uncha Hills grasslands aerial photos taken in 1949 (top),1971 (middle) and 2005 (bottom)

6.4 Restoration Options and Tools

Three management options available for grasslands: allowing natural processes to proceed; maintaining the existing grasslands; or, restoring former grasslands that have been invaded by woody species. If natural processes are allowed to proceed, there may be the continued loss of grassland area in the park. If the goal is to maintain existing grasslands, small burns could be used in early spring to burn off accumulated vegetation and to rejuvenate grasses. If the goal is to expand the grasslands, removal of large woody species, especially aspen, is needed.

A number of potential methods for woody plant removal from grasslands are available, including burning, browsing, girdling, cutting, hinging, and applying herbicides (Veenstra and McLennan 2003). These different methods were reviewed by Veenstra and McLennan (2003), for use in the former Prince Rupert Forest Region; a summary is provided in Table 19.

Table 19. Pros and cons of control methods for aspen and other woody species in grasslands[a]

Method	Cons	Pros
Burning The timing of burns can vary from early spring to late summer.	• Will get suckering from aspen and other woody species • Fire may not be possible because of insufficient grassy fuels • May require repeated burning, or different subsequent treatment to control woody species; less frequent burns needed once initial control is achieved • Potential for fire to escape target area and burn other non-target areas including local infrastructure • Lack of recent fire may have led to fuel build-up, resulting in hotter fires than desired, including crown fires • May facilitate weed invasion • Smoke may reduce air quality	• May stimulate the growth of desired species • Many desired species are resistant to fire, while some exotic invasive species may not be • Historically, grasslands were partly maintained by fire • Reduces build-up of fuel, and thus risk of wildfire
Browsing/Grazing	• Will only control suckers • May need heavy grazing for sucker control • Grazing will require cattle within the park • Inability to control browsing by wild species such as moose and deer • Grazing and browsing likely only played small role in grassland ecology in the Skeena Region • May promote unpalatable species such as snowberry	• Moderate to heavy grazing can be used in conjunction with other methods to control suckers • Grazing and browsing by wild ungulates have played a role in grassland ecology in North America
Cutting the tree down	• Can be expensive to carry out • Will produced many suckers • Need to remove suckers yearly for up to 7-8 years to exhaust root reserves; may be shorter period on dry sites • Increased coarse woody debris if not removed	• Some suckers will die due to competition, and from shading by the dead stem • May stimulate growth of understory grasses and herbs

Table 19. Pros and cons of control methods for aspen and other woody species in grasslands[a]

Method	Cons	Pros
Girdling Killing the tree by cutting into the cambium layer around the tree	• Can be expensive to carry out • Will get some suckering	• Reduces aspen vigour and abundance • May promote root decay • Will kill the tree with much less suckering than cutting the tree down •
Hinging Bending young trees over to maintain apical dominance but reducing growth	• Can be expensive to carry out • Will get some suckering • Little data available on effectiveness	• Some apical dominance may be maintained reducing suckering
Herbicides A variety of herbicides have been used to control aspen including Roundup (glyphosate), Hexazinone, 2,4-D and 2,4,5-T.	• 2,4-D and 2,4,5-T may need to be applied in broadcast applications, which affects other vegetation. • Herbicides are not accepted socially, especially in parks. • Appeals may be launched against any pesticide permit applications	• Spot application of Roundup and Hexazinone, applied after cutting or girdling or as hack and squirt, can be highly effective in controlling suckering. • Likely the most cost effective and efficacious control method

a – materials taken from Haeussler *et al.* 1990, Howard 1996, Veenstra and McLennan 2003 and materials within these papers

The production of suckers can be a major problem when attempting to control aspen in grasslands. All methods, except herbicides will produce some suckering. But recommendations in this report will follow BC Parks policy, which states “The use of chemical herbicides in parks and ecological reserves will be eliminated where possible in favour of biological, mechanical, or design methods for vegetation control.” (BC Parks 1999). Girdling aspen still produces suckers, but the number of suckers declines greatly over time, especially in the first 4 years (Bancroft 1989). The conversion of aspen stands to other vegetation types may be relatively easy on dry sites where trees are not as vigorous as mesic sites.

Because the lack of fire is the most important factor influencing the invasion of grasslands by woody species, prescribed burning is often thought of as the solution for restoring grasslands to their former state. However, prescribed fire is not necessarily an easy solution. Several potential problems exist in using prescribed fire to remove aspen, including:

1. it may be difficult to initiate fire in aspen stands because of their low fire behaviour potential,
2. high levels of fuel build up may lead to hotter fires than desired, with negative effects to desirable species and the litter layer,
3. the proximity of infrastructure such as residences, farms, and powerlines,
4. the response of target woody species, especially aspen, to burning including high levels of resprouting after burning, and
5. the potential need for repeated burning to control woody species, especially aspen.

Despite these potential problems, the most economical method for removing woody plants from larger portions of grassland areas area in Uncha Mountain Red Hills Park is likely prescribed fire.

6.5 Range Management Considerations

A major concern with cattle grazing in the park is the potential for introduction of weeds. The Range Use Plan for the Grazing Licence covering the Red Hills contains the objective of “control of designated weeds of concern from spreading and to limit the establishment of new weed infestations". The strategies in the Range Use Plan, given that it doesn't identify the presence of weeds in the tenure area, are:

1. to reduce the risk of weed establishment, all seeding in the area will occur with certified seed, and
2. if an infestation is located, Forest Service staff must be notified immediately to determine a treatment method.

Although the 2004 Range Use Plan states that no weeds have been identified in the tenure area, the Ministry of Forests and Range Invasive Alien Plant Program Application (Ministry of Forests and Range 2006a) shows numerous occurrences of orange hawkweed and several occurrences of Canada thistle in the tenure area, outside of the park; these occurrences were all identified between 2000 and 2004. The main seed dispersal method of both of these species is by wind, with dispersal distances of >2 km (Ministry of Forests and Range 2006b).

6.6 Invasive Plants

When conducting management activities that involve the disturbance of soils or vegetation, there is potential for creating conditions that facilitate the establishment or increase in invasive plant species. An inventory of invasive plants was not conducted as part of this project. The database of the Ministry of Forests and Range's Invasive Alien Plant Program (Ministry of Forests and Range 2006a) shows a number of invasive plants within 10 km of Uncha Mountain Red Hills Park (Table 20), but none within the park. Most of these recorded occurrences were greater than 3 km from the park boundary; however, no invasive plant surveys have been conducted in the park. Most occurrences were west and northeast of the Red Hills portion of the park. Species listed in Table 20 should be considered a preliminary list of invasive plants that could occur within the park. Canada thistle and oxeye daisy likely occur in the park (B. Fowler *pers. comm.,* District Agrology Officer, Ministry of Forests and Range). There may also be non-native plant species in the grasslands that may not be considered invasive plants, but do not naturally occur in the area.

In areas where restoration or rehabilitation activities are planned, the Best Management Practices for the prevention of invasive plant establishment should be followed (Miller and Wikeem. 2006). The Northwest Invasive Plant Council is actively working to eradicate invasive plants in the region. They are willing to work in provincial parks but need an agreement with BC Parks before working in a park.

Table 20. Invasive plants found with 10 km of Uncha Mountain Red Hills Park

Common Name	Latin Name	Comments
Canada thistle	*Cirsium arvense*	
Common tansy	*Tanacetum vulgare*	
Dalmatian toadflax	*Linaria dalmatica*	
Foxtail barley	*Hordeum jubatum*	
Gronovius hawkweed	*Hieracium gronovii*	
Lamb's quarters	*Chenopodium album*	
Meadow goats-beard	*Tragopogon pratensis*	
Orange hawkweed	*Hieracium aurantiacum*	Species of high concern in region - spreading
Oxeye daisy	*Leucanthemum vulgare*	Species of high concern in region - spreading
Perennial sow thistle	*Sonchus arvensis*	
Scentless chamomile	*Matricaria perforata*	Species of high concern in region - spreading
Yellow hawkweed	*Hieracium pratense*	Species of high concern in region - spreading
Yellow/common toadflax	*Linaria vulgare*	

6.7 Restoration Needs

The loss of grasslands due to encroachment, as shown by the historical airphotos, has compromised the species that occupy and use these grasslands. In the Skeena Region, grasslands occupy a small portion of the landscape; therefore all grassland occurrences are regionally important for these species. Maintaining grassland ecosystems presents challenges for managers; but these ecosystems must be maintained on the landscape because of their special role (Haeussler 2000).

Caution must be taken to ensure that the time frame used is relevant to the ecosystems processes being examined. For example, successional processes after fire may take a century or more, and we presently do not have data indicating what the ecosystem was like over that timeframe. Anecdotal evidence suggests that a large fire swept through the area approximately 130 years ago (B. Matthews *pers. comm.,* local resident), but what the vegetation was like prior to that fire is unknown.

Anecdotal evidence also suggests that the quality of ungulate browse has declined as the forest has undergone succession. Some of this browse is in areas that were formerly grasslands. Fires in grassland areas would rejuvenate some browse species, improving the quality of the ungulate forage (Ungulate Winter Range Technical Advisory Team 2005). While the main focus is on maintaining the open grasslands, actions that restore the grasslands may also improve forage quality.

Based on direction given in the management plans, input received from stakeholders, and recommendations in other reports (Haeussler 1998, Veenstra and McLennan 2002) the local community has noticed a change in the Red Hills over time and are in favour of restoration activities. Also, an assessment of restoration needs in the former Prince Rupert Forest Region ranked the grasslands in the SBSdk as one of the highest restoration priorities in the region (Holt 2001).

The need for restoration of ecosystems processes, especially fire is thus high, and will assist with the long-term maintenance of the grasslands.

6.8 Restoration Prescriptions

6.8.1 SBSdk/81

Without a detailed inventory, it is not possible to determine the specific plant communities being encroached upon by aspen in the park. Based on the landscape type and sites visited, it will be assumed that the open vegetation types in the Red Hills and Uncha Lake areas will be SBSdk/81. This does not apply to the grasslands on the Shannon Property, which are assumed to be SBSdk/82. Before any restoration activities are undertaken, a more detailed inventory will be needed to verify that assumptions are correct.

The grassland occurrences near Uncha Lake, appear to be in relatively good condition with little need of restoration. The grasslands in this area do not have a large grass component (Figure 1), so there may not be sufficient fuels to carry a fire. Some small coniferous trees are located in the grasslands; the number of these should be monitored, and trees should be removed if more trees establish. These areas could be used as reference areas to judge the success of restoration efforts, but the vegetation may not be totally comparable.

For the grassland occurrences in the Red Hills and the Uncha Hills, at a minimum the management option of maintaining the existing grasslands is recommended. In appropriate areas, the management option of expanding the existing grasslands could be explored by linking to the experimental regime of prescribed fire, cutting and girdling being proposed by the Bulkley Valley Centre for Natural Resource Research and Management (BV Centre) – Sybille Haeussler.

The BV Centre has been working on securing funding to continue restoration work on SBSdk/81 and 82 communities in the Skeena Region that was initiated by Oikos Ecological Services and Sybille Haeussler in 2001. That project did not include sites in Uncha Mountain Red Hills Park, but there are natural links between that project and Uncha Mountain Red Hills Park. Sybille Haeussler, the proposal author, is interested in extending the BV Centre project to include Uncha Mountain Red Hills Park. Potential benefits of linking the projects include sharing information gained as part of an adaptive management process.

To maintain the existing grasslands, the following restoration efforts are recommended.

1. Visit all mapped grassland to determine which are in greatest need of restoration, where restoration is most likely to succeed, and where reference plots should be located.
2. Establish monitoring and reference plots before conducting any on ground activity. These plots will record the current vegetation composition and wildlife activity through fecal pellet counts following methods in Veenstra and McLennan (2002) and RISC (1998).
3. Assess the area to determine if a burn will be feasible given fuels on the site.
4. If a burn is feasible, initiate planning for and complete a prescribed burn using expertise from the Northwest Fire Centre and Nadina Forest District. Planning will need to consider:
    a) timing a spring burn prior to green up; however, there is a higher risk of crown fire in the spring if fire is allowed to get into the crowns, due to the low for foliar moisture content in the spring; problems may occur at top of a slope where there is a transition from grass slope to conifers.
    b) the potential for fire to escape the target area. Burning some area covered in shrubs or aspen would be desirable, but a crown fire would be undesirable.
    c) impact to non-target vegetation. There is Rocky Mountain juniper in the area that should be protected. Fuels may need to be raked from the base of these trees.

5. If a burn is not feasible, fuels may be increased by manually girdling or hinging aspen and conifers that may be in or on the edge of the grassland. This may increase the light availability, plant growth and eventually increase fuel loading to allow a burn in the future.
6. Remeasure monitoring plots in the year following management activities and analyse data.
7. Reburn any burnt areas to continue control of woody vegetation. It may take a number of years before there are enough fuels to carry another fire, but repeat burns are needed to control woody vegetation.

The risks in this prescription are:

1. the potential for facilitating weed invasion or expansion; this is addressed in Section 6.6,
2. the potential that woody species will not be controlled; adaptive management through working with similar projects will allow learning to occur,
3. the potential for fire escape; burning early in the year will limit this potential,
4. excessive smoke bothering local residents; burning with good venting conditions will prevent this, and
5. lack of funding preventing project from continuing until completion.

The Office of the Wet'suwet'en indicated that the trails and cultural sites on the south end of Uncha creek may need special consideration, if prescribed fires were planned for that area, but that small prescribed burns may not affect their integrity.

A concern raised by several residents is the potential for increased ATV or snowmobile access in the park due to park management activities. Activities that may facilitate ATV access, such as widening trails, must not occur.

6.8.2 SBSdk/82

The grassland area within the Shannon Property is assumed to be SBSdk/82, based on the gentle terrain and the lack of shrub vegetation. Before any restoration activities are undertaken, a more detailed inventory needs to be conducted to verify the grassland classification. This inventory should also assess the number and density of native and exotic species present to determine whether the grassland is still in good enough condition that recovery to a more natural state is possible.

The goal for this grassland should be the maintenance of the existing grasslands. Aspen has mostly colonized areas that were low shrubs in 1947, and not true grassland; attempts should not be made to turn these areas into grasslands. If the site assessment determines that the grasslands in the Shannon Property are in need of restoration that can be assisted by fire, prescribed burning should be considered for this area following the prescription for the SBSdk/81 sites.

With grazing occurring around the Shannon Property and no fencing, it can be assumed that grazing is occurring on this grassland. Eliminating cattle grazing from the grassland may assist the recovery of the grassland, but may also allow woody plant to become established. Eliminating cattle could be accomplished by fencing, or by falling trees to create a barrier to cattle movement, though maintenance of either type of barrier would be a management issue. The range tenure holder should be contacted and consulted before either of these activities is undertaken.

7 Managing Rare Forested Plant Communities

Three rare forested plant communities were identified within Uncha Mountain Red Hills Park. The need for restoration of these communities was assessed separately from MPB attacked forests and grasslands since the management issues for these forests and the restoration options differ.

Douglas-fir – Soopolallie – Stepmoss (SBSdk/04, S3, Blue-listed)

This Douglas-fir community occurs at the northwestern limit of the range of Douglas-fir. It is found on slightly dry (submesic) south-facing slopes with shallow soil; the tree layer is usually dominated by Douglas-fir, and may have lodgepole pine, aspen and birch. The Douglas-fir trees are often large veterans that have survived several fires. The shrub layer is dominated by soopolallie, and to a lesser extent, Saskatoon, prickly rose and birch-leaved spirea (Banner *et al.* 1993).

This community is important for wildlife due to the presence of large Douglas-fir trees in the form of both live trees and snags (Fenger *et al.* 2006), for deer winter range as Douglas-fir foliage is a major component of deer winter diet (Waterhouse *et al.* 1994), and its association with critical habitats in the area (O'Neil 1998).

The open canopy of these Douglas-fir stands develops through repeated burning of the forest floor. Without fire these stands may experience in-growth of spruce, subalpine fir and lodgepole pine, and Douglas-fir regeneration (Haeussler 1998). While the SBSdk is classified as Natural Disturbance Type 3 (ecosystems with frequent stand initiating events) (Ministry of Forests 1995), this community fits best in Natural Disturbance Type 4 – ecosystems with frequent stand-maintaining events.

Three adjacent patches of SBSdk/04 covering 27 ha are located in the Red Hills area, based on Douglas-fir leading polygons on forest cover maps (Figure 15, Map 3). These stands were not visited as part of this project; however, from field notes by J. Pojar, they appear to be open stands of Douglas-fir trees <200 years old with some lodgepole pine, aspen, spruce and birch and abundant Douglas-fir regeneration. The forest cover map indicates they are pure Douglas-fir stands 141-250 years old. Haeussler (1998) indicates that these occurrences are in good condition.

Figure 15. Oblique view of Douglas-fir stands (lowermost conifer stands in semi-circle above lake) on the Red Hills

Additional Douglas-fir stands are located on the northeast slopes of Uncha Mountain and at the eastern end of the Uncha Mountain portion of the park. The eastern end of the park was formerly in the SBSdk, but has recently been reclassified as SBSdw3. This is appropriate, as these stands were on north-facing slopes that were more mesic than the Red Hills occurrences. The occurrences on Uncha Mountain also likely fit the SBSdw3 classification better than the SBSdk. Further mention of restoration of Douglas-fir stands will exclude these stands, though these areas are valuable because of their location at the northwestern edge range of Douglas-fir.

Lodgepole pine – Juniper – Ricegrass (SBSdk/02, S3, Blue-listed)

This plant community is found on rocky ridge crests, rock outcrops and gravelly terraces. The very dry sites support open, poorly growing stands of lodgepole pine, with common juniper and kinnikinnick prominent in the shrub layer, and reindeer lichens dominant in the moss layer (Banner *et al.* 1993). The variety of plants, insects, mosses, lichens and fungi found on these sites is unusual on the landscape. The long-term persistence of these sites is facilitated by fire. These sites have high wildlife value as deer winter range (Haeussler 1998). Small scale, low intensity prescribed fires may be possible on these sites at the appropriate times (Haeussler 1998).

Occurrences on rocky south-facing ridge crests are thought to be at less risk from development than those on rapidly drained eskers, terraces and sand deposits (Haeussler *et al.* 1998). The occurrences in Uncha Mountain Red Hills Park that were visited were on dry ridge crests (Figure 16). Tree death from MPB will create a more open plant community on these sites, and tree regeneration may be slow due to the dry conditions. Understory vegetation responds to increased light and moisture, with kinnikinnick having the greatest response on dry sites, with crowberry, twinflower, and red-stemmed feathermoss also responding(Williston *et al.* 2006).

Figure 16. Lodgepole pine – Juniper – Ricegrass community on ridgecrest near Uncha Lake

Spruce - Devil's club, Cottonwood - Devil's club seral association (SBSdk/00, S4, Yellow-listed)

This ecosystem is very similar to and best fits as a deciduous seral stage of the SBSmc2/09. Areas containing this ecosystem were previously thought to contain Cottonwood - Dogwood - Prickly rose (SBSdk/08), but were never inventoried. The site visited on the ground and viewed from the air did

Figure 17. Spruce - Devil's club, Cottonwood - Devil's club seral association

not fit the SBSdk/08 classification, but more closely resembled the SBSmc2/09 (Figure 17) [3]. Other areas containing this ecosystem have been documented on cool north-facing slopes along Babine Lake, also in the SBSdk (A. Banner *pers. comm*., Research Ecologist, Ministry of Forests and Range). The Spruce - Devil's club seral association us a rare ecosystem in the SBSdk, and would fall through the cracks of the BEC classification system, which was not meant to identify rare ecosystems.

This ecological community was found on a north-facing fan on the south shore of François Lake. The forest canopy was dominated by cottonwood, with minor amounts birch in the main canopy, and small amounts of spruce either sub-dominant or in the sub-canopy. Devil's club was the dominant shrub with thimbleberry also very common; black twinberry, highbush cranberry, prickly rose and Sitka alder were also present.

7.1 Historical Airphoto Comparison

The only forested plant community examined using the historical airphotos was the Douglas-fir community on the Red Hills. The Douglas-fir stands in the Red Hills consist of three patches that are fairly close together on south to southwest facing slopes; they can be seen as the three dark patches on the 1971 photo (Figure 18).

In 1947, these stands were very open, set in a mix of shrubby areas and grasslands. There were some areas with young conifers especially in the southern and eastern patches. By 1971, density of young conifers increased in the southern and eastern patches, and young conifers were establishing in and around the western patch. The density and height of aspen in the area also appeared to increase by 1971. By 2005, the density of young conifers had increased significantly since 1947.

7.2 Restoration Tools and Options

Forested plant communities can require restoration if in-growth has occurred, where open forests have dense regeneration. This changes the stand structure and makes the stands much less suitable as ungulate habitat as forage species are suppressed, and increases the risk of a crown fire if fire does occur. In-growth is a common problem in the open forests of the Southern Interior and East Kootenay regions, but these open forests are uncommon in the northwest. In these areas, restoration efforts include thinning and prescribed burning, alone or in combination. Thinning before burning may required where crown fire risk is high, if only a ground fire is desired.

[3] The Cottonwood – Devil's club site was located on the south shore of François Lake 5 km east of Uncha Creek at UTM 10-340368-59844552

7.3 Restoration Prescriptions

Douglas-fir – Soopolallie – Stepmoss

No restoration is needed for the Douglas-fir (SBSdk/04, S3, Blue-listed) plant community. Indications are that Douglas-fir regeneration in the Douglas-fir stands in the Red Hills area appear to be healthy (J. Pojar *field notes*). If regeneration was dominated by spruce or fir, restoration may have been required to maintain the Douglas-fir community. A more detailed field survey should be conducted to determine if in-filling is compromising wildlife habitat values of the stands.

If in-filling is an issue, manually thinning the stands, or parts of the stands, may be possible because they do not cover a large area. Prescribed fire is not recommended for this area as the understory trees could provide ladder fuels that could transmit fire to the canopy. A canopy fire would not be desirable in this community, since it would kill or severely damage Douglas-fir canopy trees.

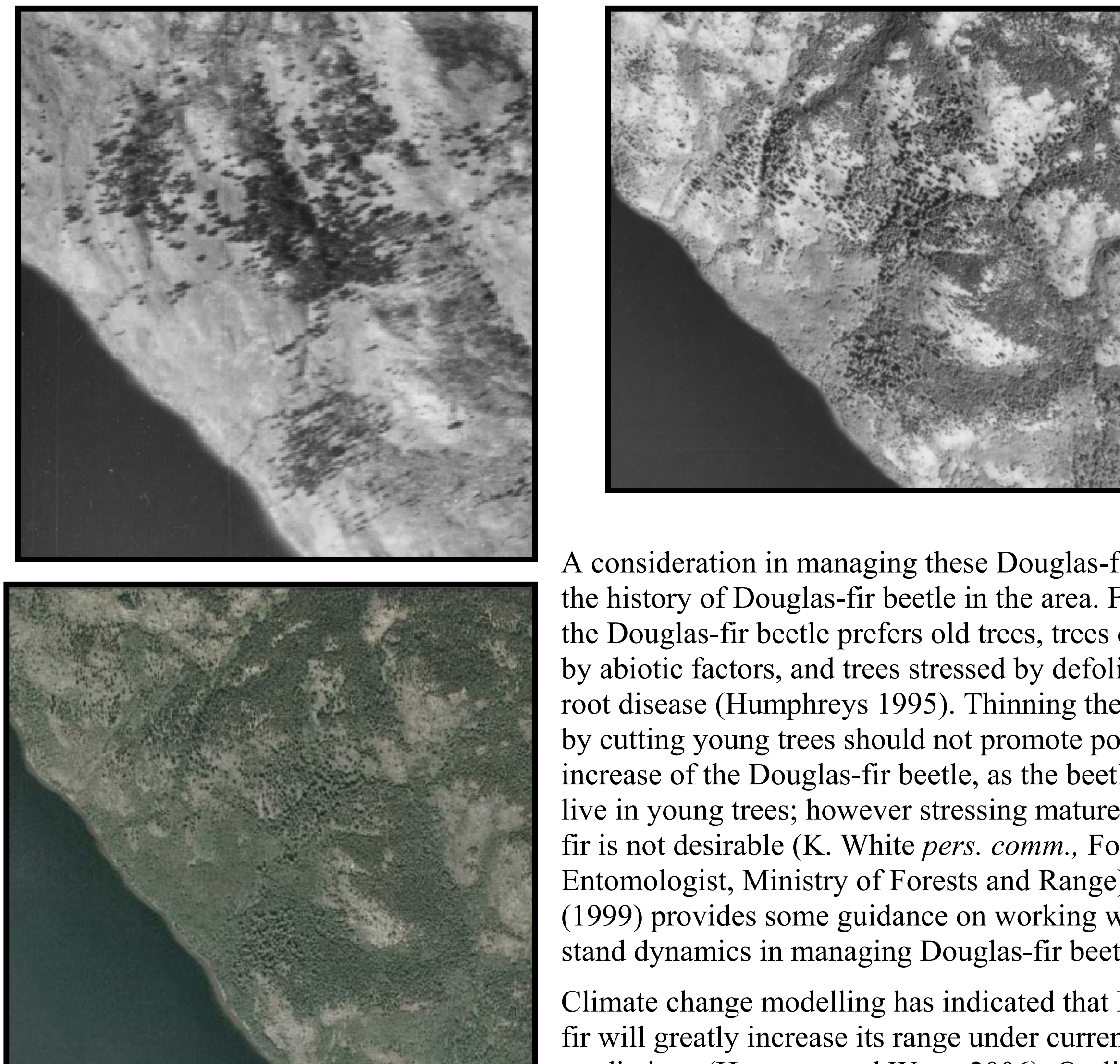


Figure 18. Aerial photos of Douglas-fir stands from 1949 (top left), 1971 (top right) and 2005 (bottom)

A consideration in managing these Douglas-fir stands is the history of Douglas-fir beetle in the area. For hosts, the Douglas-fir beetle prefers old trees, trees damaged by abiotic factors, and trees stressed by defoliation and root disease (Humphreys 1995). Thinning these stands by cutting young trees should not promote population increase of the Douglas-fir beetle, as the beetle does live in young trees; however stressing mature Douglas-fir is not desirable (K. White *pers. comm.,* Forest Entomologist, Ministry of Forests and Range). Jull (1999) provides some guidance on working with natural stand dynamics in managing Douglas-fir beetle.

Climate change modelling has indicated that Douglas-fir will greatly increase its range under current predictions (Hamman and Wang 2006). Outlier populations of plants are thought to be important in facilitating plant migration in response to climate change (Pitelka *et al.* 1997). Thus, stands at the edge of the present range of Douglas-fir, such as the ones in

Uncha Mountain Red Hills Park, will be important if predicted ecological changes occur in response to climate change.

Lodgepole pine – Juniper – Ricegrass

No restoration is needed for this dry pine plant community. The SBSdk/02 has been affected by the MPB, due to the prominence of pine in this community. However, the only possible restoration effort would be prescribed fire and/or planting with pine. The killing of trees by MPB should be viewed as a part of the natural dynamics of these stands. A new generation of trees will eventually get established on these sites, precluding the need for any restoration efforts. Natural wildfire may also occur, which is also part of the natural dynamics of these stands.

Spruce - Devil's club, cottonwood - devil's club seral association

No restoration is needed for the cottonwood seral stage plant community. This community is not a fire dependent ecosystem, and does not contain any pine.

8 Monitoring

The focus of this section is monitoring grasslands, as this is the only ecosystem where vegetation management activities are recommended. An essential component of any restoration effort is monitoring to evaluate if restoration goals are being met. The use of reference ecosystems and pre-treatment measurements are key in monitoring, so that changes to the restored area can be compared to pre-treatment condition and against an unmanipulated area. Both contemporary ecosystems that are relatively pristine, and historical ecosystems can be used for reference conditions.

Unimpacted reference ecosystems are often hard to locate due to the widespread effects of human activities. The best reference areas for SBSdk/81 may be at Uncha Lake where there is a history of grazing by cattle, but cattle have been absent since park establishment. Other reference areas may be steep areas in the Red Hills where grazing may be light, and in the Euchiniko Sidehills, 90 km to the southeast, where Simonar and Migabo (2004b) described SBSdk/81 ecosystems in pristine to excellent condition.

A variety of methods have been used to monitor grassland vegetation change over time (Veenstra and McLennan 2002, Gayton 2003) and the naturalness of grassland vegetation (Simonar and Migabo 2004b). The primary changes that monitoring would assess are changes in:

- the number and extent of woody species, especially aspen but also snowberry,
- percent cover of exotic species, and
- amount of ungulate use (deer pellet counts may be appropriate).

Sybille Haeussler, Skeena Forestry Consultants, has been working to continue the project on restoration of SBSdk/81 grasslands described by Veenstra and McLennan (2002). This project has a substantial amount of baseline data on these ecosystems, though they were all impacted by fire suppression and/or grazing. Coordinating restoration activities and monitoring with Haeussler's project, will benefit both projects.

9 Knowledge Gaps

9.1 Vegetation

Before the prescriptions in this report can be fully implemented, an inventory of flora and vegetation types needs to be completed.

The Douglas-fir stands in the park are at the northwest edge of the range of Douglas-fir, but little is known about the stand development dynamics (Jull 1999). With climate change, species occurrences at the edge of their range will likely be the ones first responding to changed conditions. The stands in Uncha Mountain Red Hills Park are ideal for a stand development study since they occur on a variety of aspects and conditions, and would provide information on stand dynamics in the area.

9.2 Fire

Knowledge of fire behaviour in beetle-killed stands, especially older killed stands, is extremely limited at the present time. The Ministry of Forests and Range has been doing research into the fire dynamics of recently killed stands, but research into the fire dynamics of older killed stands, once dead trees have fallen, is lacking.

9.3 Cultural Values

Generally, knowledge of about cultural values in the park is lacking. Although some general information about uses in the park exists, information on the location of these activities is lacking. Only two archaeological sites are recorded with the Archaeology Branch in the park. Location of some trails, camp locations and culturally modified trees were received anecdotally from local residents during the project, but this just confirmed the need for a comprehensive archaeological inventory.

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Appendix 1: Latin and common names of species used in text

Trees

Black cottonwood	*Populus balsamifera* ssp. *trichocarpa*
Black spruce	*Picea mariana*
Douglas-fir	*Pseudotsuga menziesii*
Interior spruce	*Picea glauca*
Lodgepole Pine	*Pinus contorta*
Paper birch	*Betula papyrifera*
Rocky Mountain juniper	*Juniperus scopulorum*
Subalpine fir	*Abies lasiocarpa*
Trembling aspen	*Populus tremuloides*

Shrubs

Choke cherry	*Prunus virginiana*
Common juniper	*Juniperus communis*
Crowberry	*Empetrum nigrum*
Dogwood	*Cornus stolonifera*
Kinnikinnick	*Arctostaphylos uva-ursi*
Prickly rose	*Rosa acicularis*
Saskatoon	*Amelanchier alnifolia*
Snowberry	*Symphoricarpos albus*
Twinflower	*Linnaea borealis*

Herbs and mosses

Aster	*Aster* spp.
Bluegrass	*Poa* spp.
Cow-parsnip	*Heracleum lanatum*
Fireweed	*Epilobium angustifolium*
Large-leaved avens	*Geum macrophyllum*
Meadowrue	*Thalictrum occidentale*
Needlegrass	*Stipa* spp.
Pasture sage	*Artemesia frigida*
Peavine	*Lathyrus nevadensis*
Pinegrass	*Calamagrostis rubescens*
Pumpelly brome	*Bromus inermis* ssp. *pumpellianus*
Red-stemmed feathermoss	*Pleurozium schreberi*
Rocky Mountain sedge	*Carex saximontana*
Slender wheatgrass	*Elymus trachycaulus*
Stepmoss	*Hylocomium splendens*
Timber oatgrass	*Danthonia intermedia*

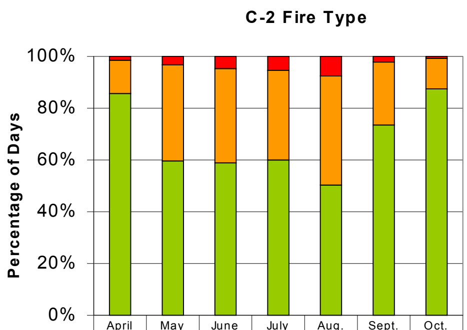
Animals

Bison	*Bison bison*
Black bear	*Ursus americanus*
Coyotes	*Canis latrans*
Elk	*Cervus elaphus*
Fisher	*Martes pennanti*
Lynx	*Felix lynx*
Marten	*Martes americana*
Moose	*Alces alces*
Mountain pine beetle	*Dendroctonus ponderosae*
Mule deer	*Odocoileus hemionus*
Rainbow trout	*Oncorhynchus mykiss*
Snowshoe hare	*Lepus americanus*
Douglas-fir beetle	*Dendroctonus pseudotsugae*

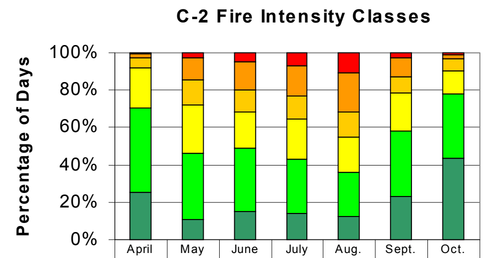
Fungi

Dothistroma	*Dothistroma septosporum*

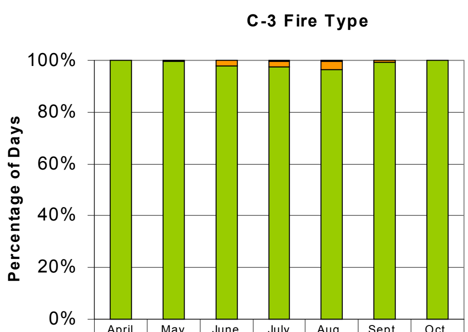
Appendix 2. Detailed Fire Climatology Data



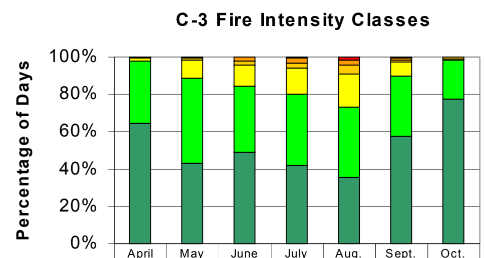
	April	May	June	July	Aug.	Sept.	Oct.
Continuous Crown Fire	1.4	3.2	4.7	5.5	7.5	2.1	0.7
Intermittent Crown Fire	12.9	37.2	36.4	34.4	42.0	24.4	11.7
Surface Fire	85.7	59.6	58.9	60.1	50.5	73.5	87.6



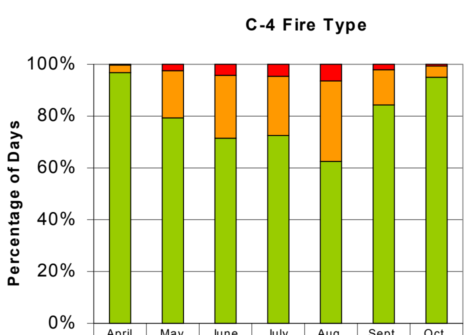
	April	May	June	July	Aug.	Sept.	Oct.
Fire Intensity Class 6	0.5	2.9	5.1	6.8	10.7	2.9	1.1
Fire Intensity Class 5	2.4	11.8	14.9	16.4	20.8	10.2	2.0
Fire Intensity Class 4	5.2	13.1	12.0	12.1	13.8	8.5	6.7
Fire Intensity Class 3	21.4	25.8	19.1	21.6	18.7	20.1	12.0
Fire Intensity Class 2	45.2	35.9	33.9	29.1	23.5	35.4	34.4
Fire Intensity Class 1	25.2	10.5	15.1	14.0	12.4	22.9	43.8



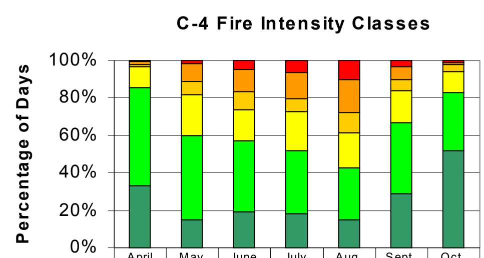
	April	May	June	July	Aug.	Sept.	Oct.
Continuous Crown Fire	0.0	0.0	0.0	0.3	0.4	0.1	0.0
Intermittent Crown Fire	0.0	0.3	2.3	2.1	3.1	0.5	0.0
Surface Fire	100.0	99.7	97.8	97.6	96.5	99.4	100.0



	April	May	June	July	Aug.	Sept.	Oct.
Fire Intensity Class 6	0.0	0.0	0.2	0.7	1.7	0.3	0.0
Fire Intensity Class 5	0.0	0.4	2.0	2.8	2.8	1.1	0.2
Fire Intensity Class 4	0.5	1.2	2.3	2.4	4.6	1.4	0.7
Fire Intensity Class 3	1.9	9.5	11.2	14.0	17.9	7.5	0.9
Fire Intensity Class 2	32.9	46.0	35.6	37.9	37.4	32.0	20.9
Fire Intensity Class 1	64.8	42.9	48.7	42.2	35.6	57.7	77.3



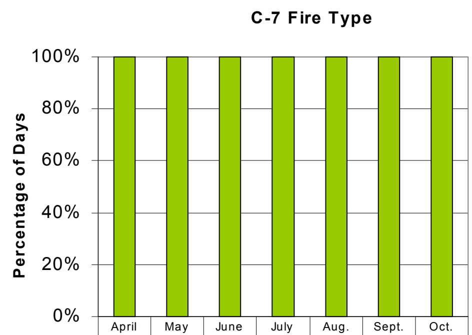
	April	May	June	July	Aug.	Sept.	Oct.
Continuous Crown Fire	0.5	2.4	4.2	4.8	6.5	2.0	0.6
Intermittent Crown Fire	2.9	18.4	24.3	22.8	31.1	13.5	4.4
Surface Fire	96.7	79.2	71.4	72.4	62.4	84.4	95.0



	April	May	June	July	Aug.	Sept.	Oct.
Fire Intensity Class 6	0.5	1.6	4.8	6.2	10.2	3.0	1.1
Fire Intensity Class 5	1.4	9.4	11.7	14.0	17.4	7.4	0.9
Fire Intensity Class 4	1.4	6.9	9.7	7.3	10.7	5.6	3.7
Fire Intensity Class 3	11.0	22.4	16.6	20.6	18.7	17.1	11.3
Fire Intensity Class 2	52.4	44.7	37.9	33.7	28.3	38.2	31.2
Fire Intensity Class 1	33.3	15.0	19.3	18.3	14.7	28.7	51.8

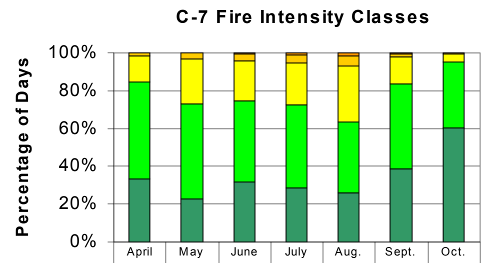
Percentage of days per month for Fire Type and Fire Intensity Class (C-2, C-3, C-4 fuel types)

C-7 Fire Type



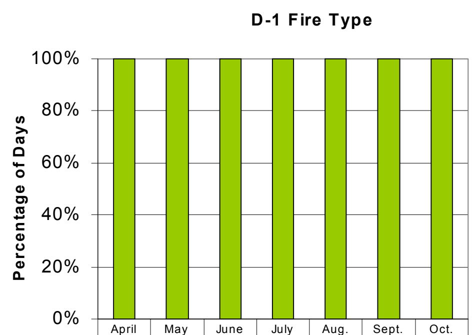
	April	May	June	July	Aug.	Sept.	Oct.
Continuous Crown Fire	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Intermittent Crown Fire	0.0	0.1	0.1	0.2	0.2	0.1	0.0
Surface Fire	100.0	99.9	99.9	99.8	99.8	99.9	100.0

C-7 Fire Intensity Classes



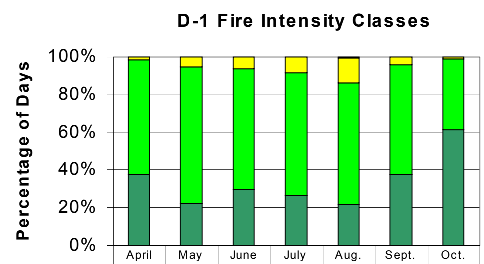
	April	May	June	July	Aug.	Sept.	Oct.
Fire Intensity Class 6	0.0	0.0	0.0	0.1	0.0	0.0	0.0
Fire Intensity Class 5	0.0	0.2	0.5	0.9	1.7	0.4	0.0
Fire Intensity Class 4	1.4	3.2	3.9	4.5	5.1	1.6	0.6
Fire Intensity Class 3	13.8	23.4	20.8	22.1	29.5	14.2	4.4
Fire Intensity Class 2	51.4	50.5	43.2	43.8	37.9	44.9	34.9
Fire Intensity Class 1	33.3	22.7	31.7	28.8	25.7	38.9	60.1

D-1 Fire Type



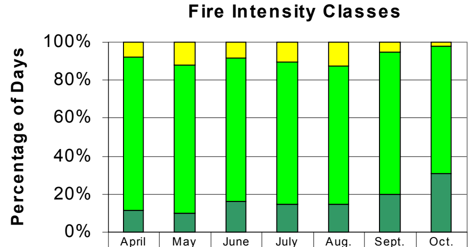
	April	May	June	July	Aug.	Sept.	Oct.
Continuous Crown Fire	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Intermittent Crown Fire	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Surface Fire	100.0	100.0	100.0	100.0	100.0	100.0	100.0

D-1 Fire Intensity Classes



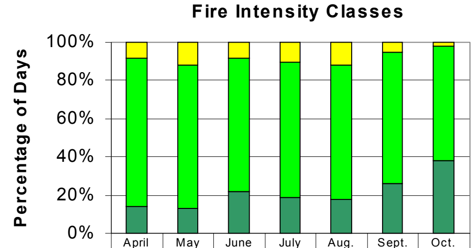
	April	May	June	July	Aug.	Sept.	Oct.
Fire Intensity Class 6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fire Intensity Class 5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fire Intensity Class 4	0.0	0.0	0.0	0.2	0.4	0.1	0.0
Fire Intensity Class 3	1.4	5.0	6.6	8.5	13.1	4.0	1.3
Fire Intensity Class 2	61.0	72.9	64.0	64.9	64.6	58.5	37.5
Fire Intensity Class 1	37.6	22.1	29.5	26.5	21.9	37.4	61.2

O-1a (65% Curing)
Fire Intensity Classes



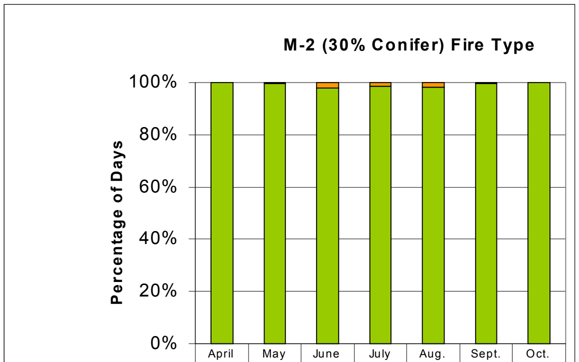
	April	May	June	July	Aug.	Sept.	Oct.
Fire Intensity Class 6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fire Intensity Class 5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fire Intensity Class 4	0.0	0.0	0.0	0.1	0.0	0.0	0.0
Fire Intensity Class 3	8.1	12.1	8.2	10.4	12.4	5.2	2.0
Fire Intensity Class 2	80.5	78.1	75.3	75.0	72.7	74.8	67.1
Fire Intensity Class 1	11.4	9.8	16.5	14.6	14.9	20.0	30.9

O-1b (65% Curing)
Fire Intensity Classes

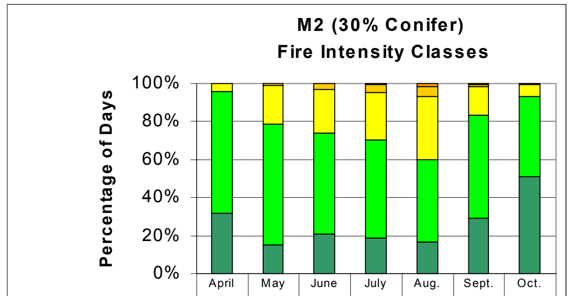


	April	May	June	July	Aug.	Sept.	Oct.
Fire Intensity Class 6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fire Intensity Class 5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fire Intensity Class 4	0.0	0.0	0.0	0.1	0.1	0.1	0.0
Fire Intensity Class 3	8.1	12.0	8.1	10.2	11.9	4.9	2.0
Fire Intensity Class 2	78.1	75.1	70.2	71.1	70.4	69.0	60.1
Fire Intensity Class 1	13.8	13.0	21.7	18.6	17.6	26.0	37.9

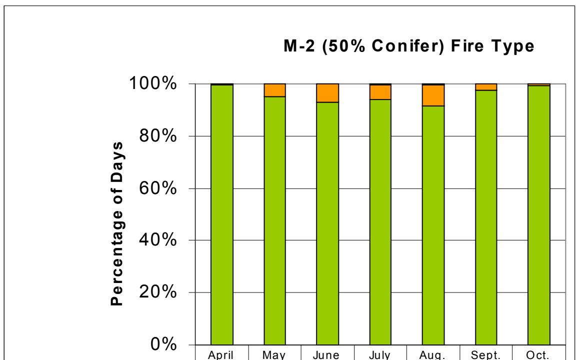
Percentage of days per month for Fire Type (C-7, D-1 fuel types) and Fire Intensity Class (C-7, D-1, O-1a and O-1b fuel types)



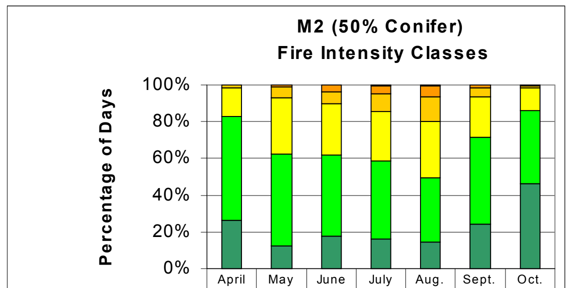
	April	May	June	July	Aug.	Sept.	Oct.
Continuous Crown Fire	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Intermittent Crown Fire	0.0	0.3	2.0	1.4	1.8	0.3	0.0
Surface Fire	100.0	99.7	98.0	98.6	98.2	99.7	100.0



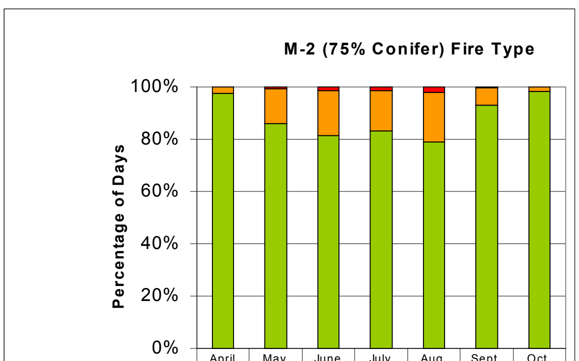
	April	May	June	July	Aug.	Sept.	Oct.
Fire Intensity Class 6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fire Intensity Class 5	0.0	0.0	0.1	0.6	1.7	0.3	0.0
Fire Intensity Class 4	0.0	0.9	3.2	3.9	4.8	1.4	0.6
Fire Intensity Class 3	4.3	20.5	22.5	25.4	33.5	15.3	6.1
Fire Intensity Class 2	63.8	63.4	53.2	51.4	43.2	54.1	42.5
Fire Intensity Class 1	31.9	15.2	21.0	18.7	16.7	29.0	50.8



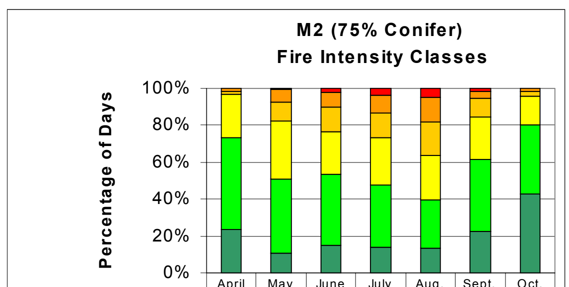
	April	May	June	July	Aug.	Sept.	Oct.
Continuous Crown Fire	0.0	0.0	0.0	0.3	0.3	0.1	0.0
Intermittent Crown Fire	0.5	4.9	7.2	5.6	8.2	2.3	0.7
Surface Fire	99.5	95.1	92.8	94.2	91.5	97.6	99.3



	April	May	June	July	Aug.	Sept.	Oct.
Fire Intensity Class 6	0.0	0.0	0.0	0.4	0.8	0.1	0.0
Fire Intensity Class 5	0.0	1.1	3.5	4.4	5.8	1.6	0.6
Fire Intensity Class 4	1.4	5.7	6.8	9.9	13.5	4.6	1.3
Fire Intensity Class 3	15.7	30.9	28.0	26.9	30.6	22.2	12.0
Fire Intensity Class 2	56.7	50.0	44.2	42.1	34.8	47.1	39.7
Fire Intensity Class 1	26.2	12.2	17.5	16.3	14.5	24.4	46.4



	April	May	June	July	Aug.	Sept.	Oct.
Continuous Crown Fire	0.0	0.6	1.3	1.6	2.2	0.4	0.0
Intermittent Crown Fire	2.4	13.5	17.2	15.2	18.7	6.5	1.9
Surface Fire	97.6	86.0	81.5	83.3	79.1	93.1	98.2



	April	May	June	July	Aug.	Sept.	Oct.
Fire Intensity Class 6	0.0	0.5	2.3	3.5	4.6	1.4	0.2
Fire Intensity Class 5	1.4	6.8	7.8	9.9	13.4	4.2	1.5
Fire Intensity Class 4	1.9	10.3	13.4	13.2	18.2	10.0	2.4
Fire Intensity Class 3	23.3	31.4	23.0	26.1	24.0	22.9	15.7
Fire Intensity Class 2	50.0	40.1	38.4	33.5	26.5	39.4	37.5
Fire Intensity Class 1	23.3	10.9	15.2	14.0	13.3	22.2	42.7

Percentage of days per month for Fire Type and Fire Intensity Class (M-2 (30% C), M-2 (50%C), M-2 (75%C) fuel types)