

SBSmm

Short- term Vulnerability = MOD
Long-term Vulnerability = MOD - HIGH

Ecological Narrative for the SBSmm through to 2080:

2008 to 2050

The influence of climate change

This subzone will likely see moderate impacts on existing stands up to 2050. Spruce and established Douglas-fir may see a slight to moderate increase in vigour and growth as climate warms and the growing season lengthens. Summers may be slightly drier, only impacting stands in extreme years. Precipitation as snow will remain relatively stable.

An increase in mature tree growth may occur due to milder temperatures, increased growing season, and continued moderate moisture inputs. This growth increase must be tempered as it carries some uncertainty. Freezing damage to growing tissues may occur as tree phenology becomes desynchronized with climate. Localized storm damage associated with climate extremes, combined with infestations of bark beetles (spruce bark beetle or western balsam bark beetle), may provide localized impacts periodically. Mortality from *Armillaria* will likely increase over time, although the extent of these impacts will be remain fragmented and localized.

The SBSmm has a relatively frequent return interval for stand replacing fires - about 125 years as an NDT3 subzone. As the climate warms, these fire events could be larger and more intense depending on fuels, with some higher risks due to localized periodic mortality. This trend may be especially evident in the lower portion of this subzone. Increased fuels from mortality in mature stands up to 2050 are anticipated to be small to insignificant, except in areas with higher levels of unsalvaged dead pine.

Increased fuel loading due to mortality in this subzone is more likely at lower elevations due to *Armillaria*, bark beetles and other insects in spruce, subalpine fir and to a lesser extent Douglas-fir. Scattered patches of aspen exist throughout in seral stands. While these may expand somewhat, they will have a relatively minor impact on modifying rate of spread should a wildfire occur.

Estimated future forest condition of stands currently mature

Lodgepole pine mortality will now result in more open stands of spruce, subalpine fir and Douglas-fir with brushy gaps. As well, warming temperatures will gradually stress subalpine fir, creating additional gaps from resulting mortality. With overhead seed sources, a multilayered structure may result. Douglas-fir and spruce could see an increase in vigour (and subsequently improved growth), particularly on north and east aspects where current growth is slow. Large wildfires may further increase early seral stands containing lodgepole pine and aspen.

Estimated future forest condition of young stands

Currently, many young stands are in lodgepole pine. These stands should remain vigorous and reasonably healthy up to and beyond 2050, although there will be growth impacts from western gall rust and comandra blister rust in years with higher spring precipitation. Localized mortality gaps from *Armillaria* will increase slightly. Growth and vigour of all young conifer stands may improve up to 2050. However, spruce will see a greater risk from terminal weevil with increasing temperatures, slowing growth throughout this subzone.

2050 to 2080

The influence of climate change

Post 2050 temperatures could be warm enough to favour Douglas-fir and stress established spruce (IDF-like), although precipitation may remain relatively high. Lodgepole pine will remain well-adapted at higher elevations and on cooler aspects, but may struggle with a host of damaging agents on warmer aspects at lower elevations. Subalpine fir will likely be outside of its ecological niche. Mortality events from both weather and insects will likely become less predictable and more severe. *Armillaria* losses may further increase but will remain somewhat fragmented.

Fuels building from mortality in this subzone may keep the risk of intense large wildfires at high levels. Large lightning-caused fire could be more frequent, especially in warm cycles when summer drought is extended. Beyond 2050 warming will reduce the amount of snowpack and length of snow season at lower elevations.

Estimated future forest condition of stands currently mature

Old stands will consist of fragmented remnants of forests impacted by mountain pine beetle and missed by large wildfires. Surviving Douglas-fir will remain vigorous on most sites except those prone to severe drought, such as steep south slopes and ridge tops. Spruce and subalpine fir as a stand component will be under stress from the warmer climate, resulting in reduced growth and increased mortality. The resulting stands will be two storied and gappy with patches of Douglas-fir and spruce (on moister sites) mixed with brush in the understory. Maturing lodgepole pine stands established early in the century will see spreading localized infestations of bark beetles adding to mortality, especially on warmer, drier sites where they will be under increased stress. If larch were previously established it will be well adapted on mesic sites. Ponderosa pine if previously established will be well adapted especially on warmer aspects at lower elevations where grassland patches may start to emerge. Aspen will thrive throughout the subzone while birch may be more prominent on cooler aspects as it moves up from lower elevations.

Estimated future forest condition of young stands

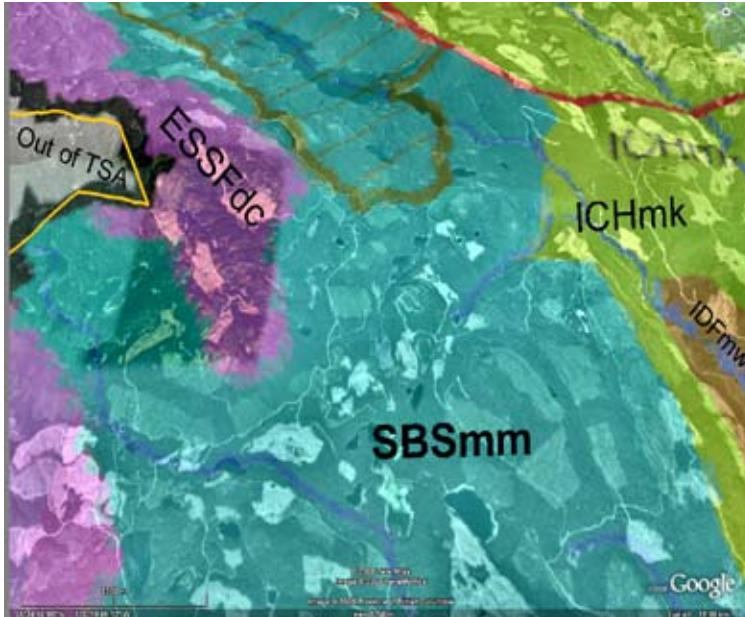
Early seral stands could be quite prominent through this subzone due to large fires. Douglas-fir will grow well on a range of sites, although impacts from *Armillaria* and periodic budworm outbreaks will be evident. On warmer aspects ponderosa pine will establish and grow well and Douglas-fir will require some shelter for establishment. Subalpine fir regeneration will be rare, and spruce will be confined to wetter sites. Young lodgepole pine may see significant mortality due to increased drought stress and a combination of insects and rusts, reducing its prominence in young stands. Aspen will maintain a strong presence in the early seral stands dominating the landscape.

Vulnerability summary

This subzone will change from one where spruce, subalpine fir and lodgepole pine are well adapted to one where Douglas-fir will be more suitable. The shift will be somewhat gradual up to 2050 with precipitation remaining fairly stable as temperature increases. Changes after 2050 will be more dramatic, with increased stress and mortality in mature stands, a higher overall fire risk and challenges for regeneration.

CURRENT CONDITIONS

2% of the TSA
3% of the THLB



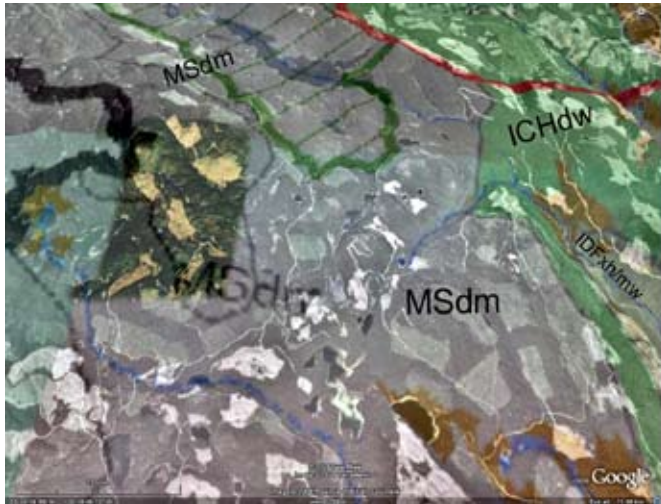
Nehalliston Ck. /
Taweel Lk.

Sites Naturally Associated with SBSmm	Plant Communities Associated with Current Subzone
Zonal site association	Trees: Sxw, PI & BI dominate; At, PI and minor Swx in seral stages; Shrubs: Huckleberry, falsebox, spirea, soopalallie; Herbs: twinflower, queen's cup, bramble, bunchberry, one-sided wintergreen: dense feathermosses
South slope site associations	Trees: PI dominates with minor At & Sxw; more At in seral stages; Shrubs: Huckleberry falsebox, spirea, rose, saskatoon & soopalallie; Herbs: Pinegrass, bunchberry, dwarf blueberry, arctic lupine; sparse feathermoss, heron's bill moss, cladina and pelt lichens
North slope site associations	See Zonal site association
Moist to Wet site association (seepages, streams and fluvial sites)	Trees: Sxw with minor BI; Act on floodplains; more PI & At in seral stages; Shrubs: Gooseberry, thinmleberry, twinberry, huckleberry, blueberry, devil's slub, dogwood: Herbs: Oak fern, lady fern, foamflower, bramble, twistedstalks: moderate cover of feathermosses

Age Classes	Leading Stand Species	% of SBSmm
<20	PI60% Sx30% (BI Fd)	27
20-60	PI47% BI47% (Sx)	7
60-120	PI60% Sx20% BI10% (Fd, At)	25
120+	PI43% Sx42% Fd10% (BI)	41

Climate Scenarios

PCM-B1 2050 (least change)



Relative Elevations	Predicted Subzone Climate	% SBSmm
Upper & Mid	MSdm	80
Rarely, a few areas may have slightly moister conditions		
Lower	IDFmw	20
Most valleys and upper boundary areas may have slightly moister conditions		

Annual Climate Variables	Now	2050	Change
mean annual temp. (°C)	2.3	3.3	1.0
mean summer temp. (°C)	12.0	13.3	1.3
mean temp warmest month (°C)	13.0	14.7	1.7
frost free period (days)	63	82	31
number of frost free days	140	157	12
mean annual precipitation (mm)	709	740	4%
mean summer precipitation (Jun-Aug) (mm)	323	320	-1%
precipitation as snow (mm)	284	280	-2%
annual heat:moisture index	18	19	4%
mean summer heat:moisture index (May-Sept)	41	46	14%

HAD-A1F1 2050 (most change)

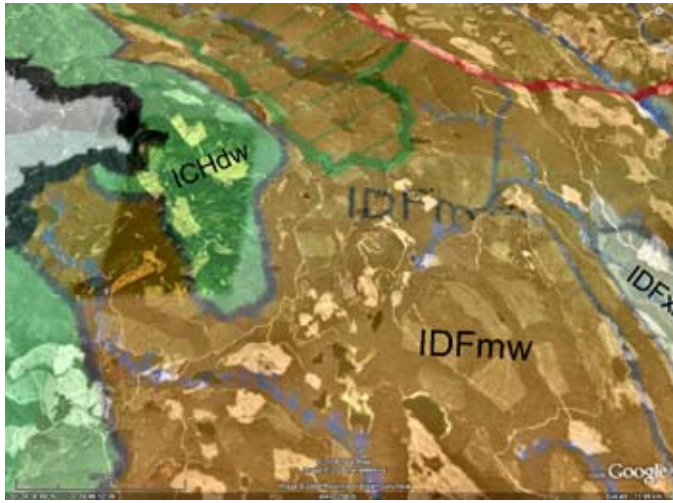
Relative Elevations	Predicted Subzone Climate	% of SBSmm
Upper & Mid	IDFmw	98
Lower	IDFxh	2

Annual Climate Variables	Now	2050	Change
mean annual temp. (°C)	2.3	5.5	3.2
mean summer temp. (°C)	12.0	16.7	4.7
mean temp warmest month (°C)	13.0	18.6	5.5
frost free period (days)	63	104	65
number of frost free days	140	186	33
mean annual precipitation	709	729	3%
mean summer precipitation (Jun-Aug)	323	290	-10%
precipitation as snow (mm)	284	238	-16%
annual heat:moisture index	18	22	23%
mean summer heat:moisture index (May-Sept)	41	65	59%

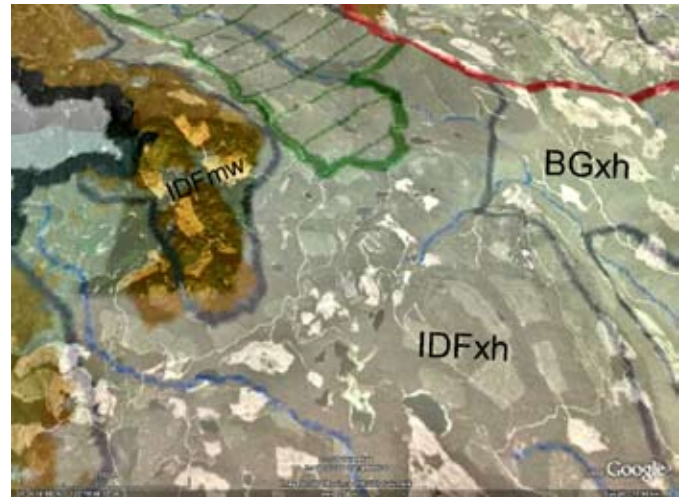
Normal summer heat:moisture index comparisons:
 ICHvk – 21-33; ICHmw – 28-56; IDFxh – 76-96; BGxh – 135-139

Looking Even Farther Ahead:

PCM-B1 2080 (least change)



HAD-A1F1 2080 (most change)



Overview of Changing Climate focussing on 2050:

General Description

Higher temperatures push this subzone into a subzone climate that is similar to something between the MSdm and the IDFmw, except that the climate will be moister than either subzone.

Summary of Ecological Vulnerabilities and Opportunities

ROOT DISEASE – Some pockets of *Armillaria* will likely start to show up.

INSECTS – May see increased problems with bark beetles and budworm.

FIRE– Fire risk will not increase appreciably unless insects reach epidemic proportions (to significantly increase fuel loads) which seems less likely than in other subzones.

Regeneration Vulnerabilities and Opportunities

ALL SITES:

- Increased use of Douglas-fir is recommended. Spruce will likely be fine at least up to 2030 when the climate trajectory for the SBSmm will be clearer. Spruce might need to be concentrated on cooler and moister sites after that time.
- Lodgepole pine will be acceptable for continued use but should be balanced with other species.
- Consider planting western larch at lower elevations on warmer aspects with slopes that drain cold air well. Over time ponderosa pine should be considered in a similar manner.

Maturing / Mature Stand Vulnerabilities

Species	Vulnerability Class ¹	Opportunity Class ²	Rationale
Sx	Low - Mod	Nil - Minor	Possibly an increase in productivity, but at the extreme (most change HAD) the spruce may be slightly stressed and more susceptible to insects – possibly bark beetles.
Fd	Low	Minor - Significant	Fd should likely increase its productivity significantly here over time. This will depend on impacts from insects and disease.
Pli	Low - Mod	Minor - Nil	Likely some increase in productivity, but could be offset by increased losses to a greater range of pests.
At	Low	Minor	At should increase in productivity and possibly quality.

¹ Vulnerability Classes

Low – Stands will suffer minor losses due to climate change.
 Mod – likely will suffer more than current losses, but will be manageable losses and or secondary risks (fire etc.)
 High – likely will suffer significant losses or incur high secondary risks, but catastrophic losses unlikely.
 Very High – likelihood for catastrophic losses are high.

² Opportunity Classes

Nil – No opportunity to enhance growth.
 Minor – Minor growth enhancement likely.
 Significant – significant growth enhancement likely.