Range of Natural Variability Assessment

Burns Lake Community Forest

Community Forest Agreement K1A

March 30, 2017

This report was compiled for the Burns Lake Community Forest by Homewood Silviculture and Keystone Wildlife Research. Information included is the best possible information available at the time of the report.

Introduction

The Burns Lake Community Forest is in the process of making an application for Forest Management Certification of its Community Forest Agreement (K1A) under the Forest Stewardship Council (FSC®). In the context of landscape planning and ecosystem management, the scope of variation in natural systems is commonly referred to as the *range of natural variability* (RONV). RONV is primarily intended to be used as a method for establishing a reference, benchmark or base case against which to measure change and assess risks of future proposed management options (e.g., Hann et al. 1997, MELP 2000).

Overview of the Community Forest Agreement (K1A)

The Burns Lake Community Forest (BLCF) was established in July 2000 when the Ministry of Forests granted Burns Lake Community Forest Ltd. a Pilot Community Forest License that consisted of 23,325 ha of Crown land. This Agreement reflected the values of the community and provided opportunities for the residents. The BLCF has undergone several expansions since that time and is now 92,304 ha in size.

In April 2005 Burns Lake Community Forest Ltd. was awarded a 25-year Community Forest Agreement (designated K1A), the first of its kind in the province. This Agreement was revised and renewed on October 1, 2014 for a further 25 years.

One of the early recommendations was that the BLCF undertake FSC Certification. A certification requirement exists in the K1A tenure document. The choice of FSC was based upon a market opportunity to sell FSC certified pulp logs and chips and the value of FSC standards and 3rd party audit in regards to the proposed BLCF environmental program. As well, FSC required a significant change in how the BLCF dealt with First Nation communities. A financial business case was made to the Board of Directors on December 9, 2015 and was approved.

Objectives of this RONV assessment

The objectives of this assessment are as follows:

- Characterization of the natural disturbance regimes;
- Characterization of the landscape level implications of the disturbance regimes; and
- Characterization of the ecosystem and stand level implications of the disturbance regimes.

Approach

"In the context of the FSC-BC Standards[1], RONV is primarily intended to be used as a method of establishing a reference, benchmark or base case against which to measure change and assess risks of future proposed management options. RONV also provides a broad set of goal posts to aim between. When RONV is used in the FSC-BC Standards with reference to a particular management outcome, it is in combination with the phrase "compatible with RONV or compatible with natural disturbance regimes"

[1] FSC BC Guidance. A companion document to the FSC-Regional Standards for British Columbia. Forest Stewardship Council Canada October 2005.

Introduction

There has been a steady increase of our knowledge of natural disturbance dynamics as a basis for forest management policy directed towards maintaining biological diversity. The underlying assumption is that the biota of a forest is adapted to the conditions created by natural disturbances and thus should cope more easily with the ecological changes associated with forest management activities if the pattern and structure created resemble those of natural disturbance.

For a variety of reasons, earlier forest management policies and guidelines in BC were directed towards setting somewhat arbitrary limits for allowable patch size or harvest amounts. These limits were often related to meeting timber volume targets, addressing perceived public concerns or creating conditions that favoured certain organisms. Limits were often stated for things such as block size, species composition, stand density, not sufficiently restocked area, and soil disturbance. Although well-meaning and easily administered, these practices resulted in landscape scale patterns bearing little similarity to those created by natural disturbance dynamics.

Adopting forest management practices that approximate the “natural range of variability” has recently been promoted as an appropriate way to manage for the needs of many organisms.

The principals of forming irregular boundaries of harvest openings to increase edge, leaving behind structure from the previous stand, and having a range of opening sizes are all examples of lessons learnt from natural disturbance that apply to the management of resilient forests in the face of climate change.

Regional Ecology

The BLCF falls within the Fraser Plateau and Basin Ecoregion (Ecological Stratification Working Group 1995). This ecoregion covers the plateaus and plains of north-central British Columbia. The region is primarily underlain by flat-lying Tertiary and volcanic bedrock that is generally below 1000 m asl in the northeast, but rises to an elevation of 1800 m asl in the west. It has a rolling surface covered by thick glacial drift into which the Fraser River and its tributaries are incised (ESWG 1995).

The moist interior natural disturbance (sub-)unit occupies the gently rolling terrain and broad mountain peaks of the Fraser Plateau and the Fraser Basin Ecoregions. This NDU is found over a wide geographic range from 53 to 55° N latitude and from 122 to 125° W longitude. The elevation range of this NDU is 600–1800 m but most of it lies between 700 and 1200 m.

The Moist Interior NDU has been subdivided into a lower elevation Plateau sub-unit that corresponds to the Sub-Boreal Spruce zone and a higher elevation Mountain sub-unit that corresponds to the Engelmann Spruce–Subalpine Fir zone due to differences in climate, vegetation, and natural disturbance patterns.

The BLCF overlaps two ecosections. The majority is within the Bulkley Basin (BUB) part of the Fraser Plateau Ecoregion. The north-east portion overlaps the Babine Upland (BAU) part of the Fraser Basin Ecoregion. The Burns Lake Community Forest covers an area of 92,062 hectares centered around the

Village of Burns Lake, and extends west to Maxan Lake, north to the Augier Main Road, east to Priestly Hill and south to the north shore of Francois Lake. It is effectively bisected by both Highway 35 (which runs north-south) and Highway 16 (which runs east-west).

Bulkey Basin (BUB)

This is a broad lowland area, lying in the northern portion of the Fraser Plateau Ecoregion. There is a strong rainshadow effect caused from its position eastward of the Kitimat and Nass ranges of the Coast Mountains. The broad valleys are filled with many lakes from the large Francois Lake, to medium sized Fraser, Tchesinkut, Tachink, Nulki and Cheslatta lakes to many smaller ones. A large, multi-armed reservoir (Ootsa, Whitesail, Natalkuz and Tetachuck lakes) from damming of the Nechako River. River drainage is via the Bulkely/Morice Rivers northward to the Skeena River or the Nechako/Endako rivers eastward to the Fraser River. The entire area was overridden by cordilleran ice moving out of the Coast Mountains southeastward in the north up the Bulkley Valley and eastward in the south in the general direction of the Nechako River. Except for small areas of higher relief that has Engelmann Spruce - Subalpine Fir zone, most of this ecosection is dominated by lodgepole pine forest in the Sub-Boreal Spruce Zone. It must be noted that most of the Lodgepole Pine forests in this ecosection have be hit with the current pine beetle epidemic. In the lower valleys, trembling aspen stands occur on the southerly-facing slopes. Extensive development and farming occurs along the Yellowhead Highway corridor of the Bulkley/Endako Valley from Vanderhoof in the east to Smithers and Moricetown in the west, and in the Francois Lake area in the south central portion of the ecosection. Extensive logging has occurred throughout this Ecosection. Francois Lake Park is the largest protected area in this ecosection, other protected areas include: the northern tip of Tweedsmuir Park extends into this ecosection on the south shore of Ootsa Lake, the Uncha Mountains Red Hills Park and Nechako Canyon protected area.

Babine Upland (BAU)

This is a rolling upland with low ridges, many small streams and wetlands and several very large lakes in the depressions, such as Babine, Tocheha, the Northwest Arm and southern reach of Takla, Trembleur, Tezzeron, Cunningham, and Stuart lakes. This ecosection is drained by the Sutherland and Fulton rivers that flow into Babine Lake; by the Babine River which drains Babine Lake and flows into the Skeena River; by the Nation River which flows into the Parsnip Arm of the Williston Lake; and by the Hautete, Middle, and Tacho rivers that drain into the large lakes which ultimately drain into the Nechako River. Logging is the main resource industry and has been extensive throughout the ecosection, however the current pine beetle epidemic has hit most the lodgepole pine stands within this ecosection. There are no communities in this ecosection although, Fort St James is located on the southeastern boundary, and summer residences and fishing lodges have been established in many places such as: at Pinchi, Middle River, Donald Landing, Smithers Landing, Topley Landing, Granisle and Fort Babine. Copper Mining occurred on Copper Island in the middle of Babine Lake east of Granisle. Rubyrock Lake, Sutherland River and the eastern half of Babine River Corridor parks are the three largest of many protected areas that have been established here.

Tree species on the Community Forest include Lodgepole pine (Pl), hybrid spruce (Sx), subalpine fir (Bl), a minor component of Douglas-fir (Fdi) and black spruce (Sb), as well as trembling aspen (At), cottonwood (Ac) and birch (Ep). Elevations in BLCF range from 700 to 1400 meters in the SBSdk, SBSmc2, SBSdw3 and ESSFmc biogeoclimatic subzones.

Table 1. BEC Variants within the BLCF.

BEC Variant	Natural Disturbance Type	Elevation (m)	Area (ha)	% of BLCF
ESSFmc	NDT2	1000 – 1800	10,202	11.0%
SBSdk	NDT3	700 – 1050	49,313	53.4%
SBSdw3	NDT3	750 – 1100	2,631	2.9%
SBSmc2	NDT3	850 – 1350	30,159	32.7%
Total			92,305	100%

General Principals

Forest that differ in time since stand replacement disturbance have different structural and functional values (Franklin et al. 2002). Old-growth forests, the most obvious example of this, are considered valuable in maintaining biological diversity, as wildlife habitat, as a benchmark for forest management, and for aesthetic and intrinsic reasons (MacKinnon 1998; Vallauri et al. 2001).

Achieving distribution of seral stages that is within the NRV is an important objective for ecosystem management. Focusing on young natural and old forest is appropriate since mid-aged forest is likely to be abundant in managed landscapes.

One, or combinations, of three main strategies for management of old forest are recommended for each natural disturbance subunit depending on the natural disturbance cycle and the historical, temporal, and spatial distribution of old forest. In landscapes with (1) high natural disturbance rates (e.g., disturbance cycle <150 Yr), (2) generally even-aged stands dominated by early seral species, and (3) few patches of very old forest (>200 yr) but large patches of older forest (>120 yr), a system of "rotating reserves" is recommended.

1) Characterization of the natural disturbance regimes

The disturbance agents are mostly wildfires, windstorms and, to a lesser extent, insects and landslides. On a landscape scale wildfires, and some epidemic level insect outbreaks are the major disturbance regimes that impact large areas and are usually considered stand initiating.

ESSF

The ESSFmc is natural disturbance type 2 (NDT2): ecosystems with infrequent stand-initiating events. Historically these forest ecosystems were usually even-aged, but extended post-fire regeneration periods produced stands with uneven-aged tendencies, notably in the ESSF biogeoclimatic zone where multi-storied forest canopies result.

Wildfires were often of moderate size (20 to 1000 ha), with unburned areas resulting from sheltering terrain features, higher site moisture or chance. Many larger fires occurred after periods of extended drought, but the landscape was dominated by extensive areas of mature forest surrounding patches of younger forest.

Wildfires in the Engelmann Spruce–Subalpine Fir zone are considered to occur relatively infrequently. They tend to be stand replacing due to the high susceptibility of some tree species to fire-caused mortality (Fischer and Bradley 1987). However, fire-initiated stands are not necessarily even-aged because post-disturbance recruitment can take many decades (Jull 1990; Parish et al. 1999). Two other important abiotic disturbance agents in the Engelmann Spruce–Subalpine Fir zone are windthrow and avalanches (Veblen et al. 1991; Ferguson and Pope 2001; Sagar and Jull 2001). Of the many biotic agents that weaken or kill trees in this zone, bark beetles, two-year-cycle budworm, western hemlock looper, decay fungi, and root rot are considered to be the most important (Lindgren and Lewis 1997).

Brochez et al. (2001) mapped seven wildfires and their residual patches in the Lakes and Morice Timber Supply Areas in west-central BC. Burns with ESSF components ranged from 53 to greater than 7618 ha, and residual patches ranged from ~1 to 245 ha.

SBS

The SBSdk, dw3 and mc2 subzones are natural disturbance type 3 (NDT3): ecosystems with frequent stand-initiating events. Historically, these forest ecosystems experienced frequent wildfires that ranged in size from small spot fires to conflagrations covering tens of thousands of hectares. Average fire size went as high as 6000 ha where topographic features did not limit fire spread. The largest fires in the province occur in this NDT, often exceeding 100,000 ha and sometimes even 200,000 ha.

Natural burns usually contained unburned patches of mature forest that were missed by fire. Consequently, these forests produced a landscape mosaic of even-aged regenerating stands ranging in size from a few to thousands of hectares and usually containing mature forest remnants.

There were also frequent outbreaks of defoliating insects and an extensive presence of root diseases. The impact of these infections on tree survival and stand structure ranged from low to severe. Tree mortality within mature forest remnants and regenerating stands resulted in dead trees, decaying logs, and canopy gaps. Riparian areas within the forest landscape provided special habitat characteristics not found in the upland areas.

Fires of moderate to high severity dominate the natural disturbance regimes of most forests in the Sub-Boreal Spruce zone (Parminter 1992). Widespread and high-severity mountain pine and spruce bark beetle outbreaks are also influential.

Estimates of fire cycles are 100 years for the dry cool subzone (SBSdk), 125 years for the moist cold subzone (SBSmc) in the Lakes and Morice Timber Supply Areas (Steventon 2001).

As a result of fires that occurred in these forests, the landscape is characterized by a mosaic of even-aged stands of different ages. Table 2 defines seral stages for the biogeoclimatic zones and disturbance type; Table 3 recommends targets for seral stage distribution in the type.

Table 2. Seral stage definitions by biogeoclimatic zones in BLCF (BGB 1999).

BGC Unit	NDT	Mean event interval	Seral stage		
			Early	Mature	Old
ESSF	NDT2	200 yr	<40	>120	>250
SBS	NDT3	125 yr	<40	>100	>140

Table 3. Recommended seral stage distribution for NDT and biodiversity emphasis option (BGB 1999).

BGC - BEO	Early	Mature + old	Old
ESSF – Intermediate	<36	>28	>9
ESSF – Low	n/a	>14	>9
SBS – Intermediate	<54	>23	>11
SBS – Low	n/a	>11	>11

A clustered harvest pattern, using large aggregated harvest units, most closely simulates the natural pattern of large fires and large unburned areas.

Table 4. Recommended distribution of patch sizes for biogeoclimatic subzones in NDT (BGB 1999).

Patch size (ha)	ESSF (NDT2)	SBS (NDT3)
<40	30-40	20-30
40-80	30-40	25-40
80-250	20-40	30-50
	Moist Interior - Mtn	**Moist Interior-Plateau**
<50	20	5
51-100	10	5
101-1000	30	20
>1000	40	70

Table 5 provides a summary of the potential mix of the various disturbance types that may occur for each of the NDTs (based on expert opinion). The values in Table 5 provide a basis for designing management regimes appropriate to the natural disturbance types and range of natural variation that may be found on a management unit.

Table 5.Estimated percentage proportions of the three main disturbance regimes within NDT.

Disturbance Regimes	Gap Replacement (%)	Stand Replacement (%)	Stand Maintaining Fires (%)
BGB - NDT2	35-60	20-55	5-20
BGB - NDT3	10-25	50-80	10-25
Moist Interior Mountain	30	70	
Moist Interior Plateau	2	98	

Fire and mountain pine beetle are the key stand replacement disturbance agents operating in the moist interior unit. The disturbance rate[2] for the plateau and mountain portions of this unit is estimated to be 0.75-1.25%[3] and 0.48% of the total forested area per year, respectively (Delong 1998). The disturbance cycles assigned to the plateau and mountain portions are 100 and 200, respectively, based on work conducted by Andison (1996) and Delong (1988).

Table 6 shows the estimated NRV in amount of different age forests that would be associated with this fire cycle. Large wildfires (>1000 ha) dominated the landscape, and sites were regenerated quickly by dense lodgepole pine and/or trembling aspen stands, resulting in large patches of relatively even-aged forests (Table 6). Minor amounts of young white and/or black spruce forest could be found in wetter patches within the fire boundaries often adjacent to unburned mature forest. Young Douglas-fir stands occur on drier ridges near larger Douglas-fir remnants. Small areas where fire was intense may regenerate to willow or alder (C. Delong, unpublished data). Stand ages rarely exceeded 200 years except in the more mountainous areas, but relatively large patches (>100 ha) of older forest (140-180 yr) could be found scattered across the landscape (Andison, 1996; Delong and Tanner 1996). Although large patches of old forest (>140 yr) generally occurred in the landscape, their position would have moved around the landscape over time. Within the boundaries of the fires, 3-15% of the total area of the fire can be composed of unburned mature forest remnants (DeLong and Tanner 1996).

During stand development, increasing amounts of white spruce, black spruce, and subalpine fir will occur in stands originally dominated by lodgepole pine or trembling aspen. This increase occurs more rapidly and these species become a more dominant portion of the canopy on wetter sites. Douglas-fir would be co-dominant where established with lodgepole pine.

Fire control and harvesting pattern are likely the two factors most affecting the natural landscape pattern and processes in this NDU.

Delong (2011 estimated the age class distribution that might have occurred naturally prior to human intervention (fire control and industrial logging). These targets have been used to establish the RONV biodiversity objectives expected within the FSC Regional Area to enable assessment and monitoring.

Table 6. Estimates of statistics relating to temporal and spatial pattern of natural disturbance in the Moist Interior Natural Disturbance Unit (Delong 2011).

NDU	BGC	Stand Replace Cycle	>250	>140	>100	<40
Moist Interior – Mountain	ESSF	200	23-37	41-61	52-72	12-33
Moist Interior – Plateau	SBS	100	6-12	17-33	28-49	25-50

Within this NDU, there is no documented evidence that MPB played a major role as a stand replacement agent before fire control (Delong 2011). Historically the fire return interval was short enough and winter

[2] All disturbance rates are for stand replacement wildfire except where noted.

[3] All estimates quoted are for the period of 1911 – 1930 because these were deemed to more accurately reflect the true natural disturbance rate.

temperatures were cold enough to limit pine beetle infestations (Delong 2011). However, that changed when the MPB epidemic hit the Burns Lake area starting in 1999, peaked in 2005 and was essentially over by 2008. Fire control, which maintained large volumes of mature timber and mild winter temperatures, related to climate change, contributed to the MPB epidemic.

The impact was that the MPB killed approximately 4.5 million m^3 (18,000 ha). Most of the attack was in the pine dominated forests of the SBS. This was followed by a salvage program and since 2000, the BLCF has harvested approximately 3.3 million m^3, 82% of the volume harvested was pine and approximately 90% of all pine harvested was dead. The salvage of the dead pine continues today and is expected to last another 5 to 8 years. Although this level of man caused disturbance exceeds previous norms it is likely less extensive than a natural wildfire.

Wildfire risk has increased due to the amount of dead timber. In 2010, the Binta Lake fire south of Burns Lake, grew to 40,000 hectares and in 2014 the Chelaslie River fire near Burns Lake grew to 133,000 hectares. While fires are natural disturbances, they can cause impacts to water quantity and quality due to increased surface water runoff, soil erosion and downstream sedimentation.

The incidence of extreme weather events is expected to increase due to climate change (IPCC 2012). As a result, the occurrence and intensity of weather-influenced disturbances such as droughts, floods, ice storms and landslides will fall outside their historical range of variability, and may negative effects on the ecosystems they operate on.

The rolling and subdued terrain of the Nechako Plateau appears relatively benign in terms of erosion and landslides. However, erosion and landslides do occur. A natural erosional event in the early 1980s transported in the order of 250 000 m^3 of sand and gravel from a glacial fluvial terrace into and down Tchesinkut Creek. The eroded gully appears very similar in shape to early post-glacial erosion cut channels through the glacial fluvial terrace above Tchesinkut Creek. Glaciofluvial sediments likely cover glaciolacustrine sediments at the Tchesinkut Creek erosional site. A natural diversion of a stream channel onto the glacial fluvial terrace caused the erosion. This type of event, sometimes called a washout-flow, has occurred catastrophically in similar glaciofluvial and glaciofluvial-glaciolacustrine sediments across British Columbia (refer to Schwab (2000, 2001a) and Geertsema et al. (2010) for a description of the processes involved in a washout-flow).

The Mountain Pine Beetle (MPB) outbreak and associated salvage logging have resulted in dead trees and significant forest clearing for timber salvage. The loss of the forest has led to hydrologic changes to surface flow, as the forested ecosystem is no longer present to absorb and filter precipitation, resulting in increased peak-flows during rainfall or snow-melt events, soil erosion and sediment deposition into streams and watercourses, as well as increased water temperatures due to loss of trees that provide shade in riparian areas

Multiple Resource Value Assessments (MRVA) are useful tools for forestry professionals and decision makers as they synthesize results of stand and landscape level monitoring of resource values as carried out under the Forest and Range Evaluation Program (FREP). These results are used to determine a MRVA score based on the level of impact from forestry practices on the resource value. Of the 55 streams monitored, 11% were rated very low or low harvest related impacts: 2% of streams are Properly Functioning, 9% are Properly Functioning ("very low" impact), 24% are Properly Functioning with limited impact, 27% are Properly Functioning with impact and 16% are Not Properly Functioning. Natural events (wind, organic stream beds, and high natural sediment levels) also impacted some of the streams. Of the 55 road segments assessed, 59% were rated as "very low" or "low" road-related impact. Site assessments show the range for potential sediment generation as 24% "very low" ("very low" impact), 35% "low" ("low" impact), 29% "moderate" ("medium" impact), 11% "high" and 2% "very high" ("high" impact). FSC Riparian requirements provide opportunities for improvement by maintaining higher levels of retention within the first 10 m of streams, particularly for S4 and S6 streams.

2) Characterization of the landscape level implications of the disturbance regimes

Delong (2011) estimated fire return intervals slightly shorter than the biodiversity guidebook for the SBS variants within the BLCF (Table 7).

Table 7. Characterizing natural disturbance regimes in the Interior of BC.

BGC Zone	Biodiversity Guidebook		Environmental Base Case		
	NDT	Return Interval	Rtn Interval Mean	Range (+/-30%)	
				Min	Max
ESSF	2	200	200	140	260
SBS	3	125	100	70	130

In applying regional objectives to an area such as BLCF (<100,000 ha) it should not be expected that specified RONV age class distributions will be met. Strategic planning initiatives on the regional landbase (PAS, LRMP, SRMP) have ensured that future land management will provide a range of forest stand ages consistent with the RONV.

Table 8. Regional biodiversity objectives and current conditions

NDU		**Std Replace Cycle**	**>250**	**>140**	**>100**	**<40**
ESSF	NE BC	**200**	**23-37**	**41-61**	**52-72**	**12-33**
	Lakes TSA		31%	73%	86%	5%
	Tweedsmuir		51%	88%	96%	0%
	BLCF		1%	37%	50%	11%
SBS	NE BC	**100**	**6-12**	**17-33**	**28-49**	**25-50**
	Lakes TSA		3%	31%	52%	22%
	Tweedsmuir		19%	66%	87%	0%
	BLCF		0%	16%	37%	32%

The current age class distributions on the much larger regional landbase used to assess RONV shows that the amount of older forest within both biogeoclimatic zones exceeds what might have been expected under natural conditions.   In fact, the proportions of younger forest on the regional landbase are low probably due to fire control.

Connectivity

Maintaining some connectivity between the old forest patches would seem warranted based on the amount of connectivity observed in the natural landscape.

Forest Estate Modelling

The PATCHWORKS ™ modeling software will be used for forecasting and analysis. This suite of tools is sold and maintained by Spatial Planning Systems Inc. of Deep River, Ontario (Tom Moore - www.spatial.ca).

PATCHWORKS is a fully spatial forest estate model that can incorporate real world operational considerations into a strategic planning framework. It utilizes a goal seeking approach and an optimization heuristic to schedule activities across time and space in order to find a solution that best balances the targets/goals defined by the user. Targets can be applied to any aspect of the problem formulation. For example, the solution can be influenced by issues such as mature/old forest retention levels, young seral disturbance levels, patch size distributions, conifer harvest volume, growing stock levels, snag densities, CWD levels, ECAs, specific mill volumes by species, road building/hauling costs, delivered wood costs, net present values, etc. The PATCHWORKS model continually generates alternative solutions until the user decides a stable solution has been found. Solutions with attributes that fall outside of specified ranges (targets) are penalized and the goal seeking algorithm works to minimize these penalties – resulting in a solution that reflects the user objectives and priorities.

- PATCHWORKS' interface allows for highly interactive analysis of trade-offs between competing sustainability goals.
- PATCHWORKS software integrates operational-scale decision-making within a strategic-analysis environment: realistic spatial harvest allocations can be optimized over long-term planning horizons. Patchworks can simultaneously evaluate forest operations and log transportation problems using a multiple-product to multiple-destination formulation. The model can identify in precise detail how wood flows to mills over a complex set of road construction and transportation alternatives.
- Allocation decisions can be made considering one or many objectives simultaneously and objectives can be weighted for importance relative to each other. (softer vs. harder constraints)
- Allocation decisions can include choices between stand treatment types (Clearcut vs. partial cut, fertilization, rehabilitation, etc.).
- Unlimited capacity to represent a problem – only solution times limit model size.
- Fully customizable reporting on economic, social, and environmental conditions over time.

Reports are built web-ready to share analysis results easily – even comparisons of multiple indicators across multiple scenarios. In this case, the PATCHWORKS resultant files for the Scenario FSC Partial Cut were provided to the project team biologists for the RONV analysis.

The following graphs summarize the analysis. The graphs shows:

- Natural Range (Delong 2011),
- BEO Intermediate and Low (Biodiversity Guidebook)
- 250 Year Projections for BLCF

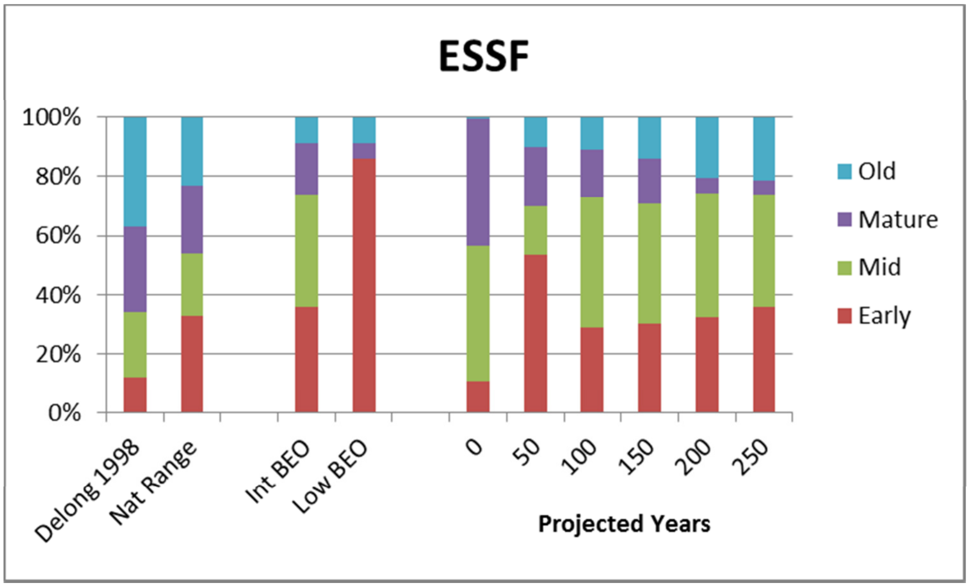

Figure 1. Seral stage targets and distribution within the ESSF.

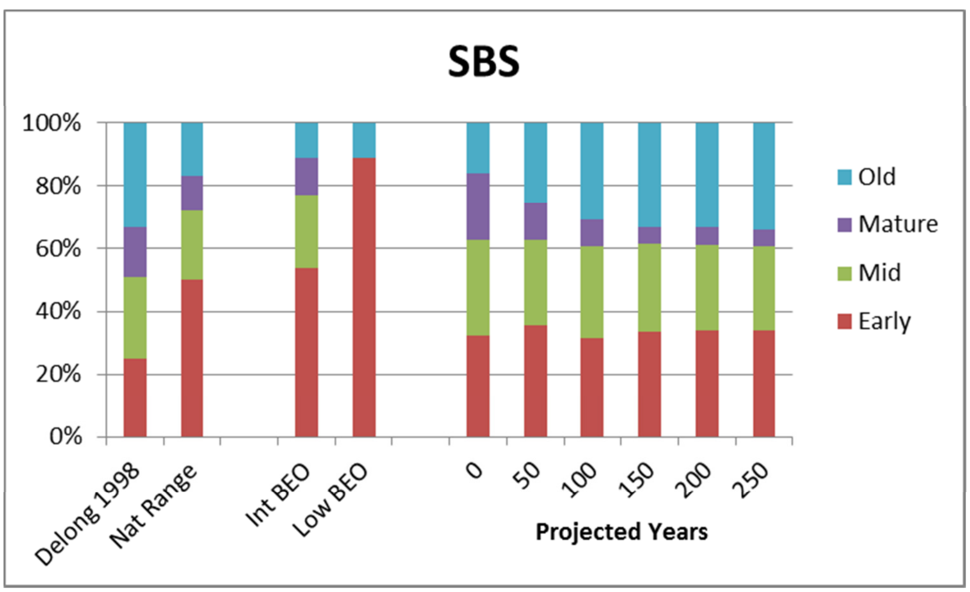

Figure 2. Seral stage targets and distribution within the SBS.

Within the BLCF proposed management will shift the age class distribution so it exceeds the FRPA targets.

Patch size: The patch size for clearcut harvesting should follow that of wildfire Table 4 as closely as possible given social, logistic, or demonstrated ecological constraints. Design of blocks should follow guidance provided in DeLong (1999).

In order to provide opportunities for the distribution of species, populations and genetic material, the Lakes LRMP includes an objective to maintain or enhance habitat connectivity at the landscape level. One method to achieve this objective is to establish a network of landscape corridors.

The pattern of these components on the landscape may be indicative of natural disturbance patterns, biogeoclimatic influence, or edatopic conditions which provide valuable information for a landscape level retention strategy. However, due to the history of anthropogenic disturbances on these landscapes (logging and agriculture), the current distribution and size of the component patches may also be indicative of a highly fragmented landscape, with only remnant structure.

3) Characterization of the ecosystem and stand level implications of the disturbance regimes

Maintaining snags, veteran trees, and coarse woody debris within predominantly even-aged stands is important for biodiversity in these NDTs. Reserving a component of old seral stages that historically have not burned is also important.

Natural forest succession in these NDTs created a mosaic of different successional stages. Species composition within these successional stages varies from early seral communities to climax communities. Maintaining that variety of species composition within seral stages is an important component of maintaining biodiversity.

RONV Interpretations

In applying regional objectives to an area such as BLCF (<100,000 ha) it should not be expected that specified RONV age class distributions will be met. Strategic planning initiatives on the regional landbase (PAS, LRMP, SRMP) have ensured that future land management will provide a range of forest stand ages consistent with the RONV. Within the BLCF proposed management will move the age class distribution closer to the targets but it is unlikely that regional targets could or should be achieved on a small portion of the landbase.

BLCF – Post MPB

How does after weathering the MPB epidemic and salvage program?

Amazingly enough, much better than one would expect:

The ESSF today:

- Has no caribou population, lower BEO
- Has had limited harvesting to date
- Could be artefact of the inventory ages
- Only 10,200 ha, so small sample
- Area >250 years is low

The SBS today:

- The mature timber was been severely impacted by MPB
- Will be focus of harvesting in short term
- The heavily constrained land base provides opportunity for mid-term timber supply if constraints are relaxed
- The long silvicultural history, mixed species stands and investments has resulted in a well established immature forest that missed the major impacts of the MPB.
- RONV looks good

What does the forest look like in 100 years, based upon assumptions in the FSC Partial Cut Scenario and plans to complete the salvage program?

- Stable flow of wood products to support the community
- MP which exceeds FRPA and meets additional FSC requirements
- Well distributed older forest in areas where old attributes are most valuable to maintain HCVFs
- Improved habitat for focal wildlife species
- Better riparian management to maintain water quality and fish habitat

Forest management Recommendations

Recommended Practices from DeLong

Old forest: Since older forests (i.e., 120-200 yr since last disturbance) are estimated to have been consistently present but very old forests (>250 yr since last disturbance) were rare in the plateau portion of this NDU, a system of rotation old forest reserves in this age range is appropriate. This would ensure stands with "old forest characteristics" exist but that the stands are not unnaturally old and more susceptible to pest infestation. Large patches (>100 ha) of old forest should be identified and recruited such that replacement areas >120 years old are available to replace areas >150 years of age that would be harvested.

Fixed reserves may be more appropriate in the mountain portions of the NDU but may be augmented with some level of floating reserve. Table 6 contains estimates of the NRV of the time since last stand replacement disturbance distribution based on the estimated fire cycle.

Patch size: Since medium-sized patched (50-100 ha) are rare in the natural landscape and small patches are still naturally created by small fires, windthrow, and root disease, the emphasis should be on creating larger patches (>100 ha) as a replacement for larger patches that would have been created by fire. Larger patches should be created by aggregating recent blocks in areas previously harvested and/or by designing new large blocks in unharvested areas. Patch size distribution should follow that of wildfire (Table 6) as closely as possible given social, logistic, or demonstrated ecological constraints. Design of blocks should follow guidance provided in Delong.[4]

Stocking and stand structure: Stand density in young circumesic stands (<40 yrs) should generally be kept at total stocking levels of >2000 sph to approximate dense natural stands. More open patch stocking (i.e., <1000 sph) on hygric sites is recommended. Even-aged stands over most of the landscape would approximate the natural pattern.

What are the key concerns BLCF forest managers should watch?

- In ESSF, maintain a range of silviculture systems
- In SBS, be vigilant with MPB and Spruce Bark Beetle
- In SBS, partial cutting can also increase risk of Spruce bark Beetle.
- Current seral stage distribution targets from FRPA still continue to support larger amounts of older forest which in itself maybe beyond the RONV.
- In SBS, areas targeted for wildlife and biodiversity will need recruitment and management plans in the future in order to maintain the flow of ecological services.

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