Implementing the Range of Natural Variability Approach for Burns Lake Community Forest

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1. Background

The conservation of biological diversity in British Columbia has become an important management consideration since the 1990's (Bunnell, 1995; Fenger, 1996; Harding & McCullum, 1994). Since that time there has been a steady increase in the use of our knowledge of natural disturbance dynamics as a basis for forest management policy directed towards maintaining biological diversity (Booth et al., 1993; British Columbia Ministry of Forests and Ministry of Envrironment, 1995; DeLong, 2007). 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 (Bergeron & Harvey, 1997; Bunnell, 1995; Delong & Kessler, 2000; DeLong & Tanner, 1996; Hunter, 1993; Swanson et al., 1994).

For a variety of reasons, earlier forest management policies and guidelines within British Columbia were directed towards setting limits or targets that often did not reflect natural conditions. These limits were often related to meeting timber volume targets, addressing perceived public concerns, or creating conditions that favoured certain organisms (e.g., ungulates). 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 and stand conditions bearing little similarity to those created by natural disturbance dynamics. Studies of natural disturbance in the boreal and sub-boreal forest have demonstrated large ranges in disturbance patch size (DeLong, 1998; Eberhart & Woodward, 1987), tree density (Delong & Kessler, 2000), and volume of coarse woody debris (CWD)1 (Clark et al., 1998; Delong & Kessler, 2000). Adopting forest management practices that approximate the "range of natural variability" (RONV) has been promoted since the 1990's as an appropriate way to manage for the needs of many organisms and is regarded as a coarse filter approach (Hunter, 1993). More recently, the RONV approach has been questioned but is still felt to provide a useful tool to inform practices rather than to set strict targets (Thompson et al., 2009). The principles 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 learned from natural disturbance that apply to the management of resilient forests in the face of climate change.

The Forest Practices Code Biodiversity Guidebook (1995) was the first attempt in British Columbia to present guidance for forest management based on the natural disturbance template. Specific guidance for seral stage distribution, patch size, wildlife tree patch amount, and spatial arrangement and more general guidance on species composition and stand structure were included in this guide. Since the completion of the Biodiversity Guidebook, more information on natural disturbance dynamics has become available. Within the eastern portion of the Omineca Forest Region, a number of studies investigated particular aspects of natural disturbance (e.g., DeLong, 1998; Delong and Kessler, 2000; Lewis and Lindgren, 2000). This resulted in the document Land Units and Benchmarks for Developing Natural-disturbance Based Forest Management Guidance for Northeastern British Columbia (DeLong, 2010) which provides the best available information for natural-disturbance based management in the region and outlines objectives and practices that would result in the least possible differences between harvesting and natural disturbance. The document presents information for ten Natural Disturbance Units (NDUs) that were derived based on differences in climate, topography and fire regime.

Although the NDU's were not mapped for the area covered by the Burns Lake Community Forest (BLCF) the climate and topography are similar to that of the adjacent Moist Interior NDU mapped in the Vanderhoof Forest District. The biogeoclimatic units, SBSdk, SBSdw3 and SBSmc2 biogeoclimatic (BGC) units fit within the Moist Interior Plateau subunit and the ESSFmc unit fits within the Moist Interior Mountain subunit, as described in DeLong (2011).

[1] All reference to CWD in this document refers to dead woody material on the ground or < 45^{o} angle to the ground if suspended.

The following sections examines various aspects of forest management in the context of natural - disturbance based guidance.

2. Seral Stage Management

Forests that differ in time since stand replacement disturbance have different structural and functional values (Franklin, 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 (Vallauri et al., 2015). Recently killed forests and young natural forests also appear to provide important habitat for some organisms that are not present in young managed forest (Schmiegelow et al., 2006). For example, Black-backed Woodpeckers (Picoides arcticus [Swainson]) are commonly associated with standing dead forests and may require recently burned forests for their long-term persistence (Hoyt & Hannon, 2002; Hutto, 1995). Certain insects and fungi appear to be either fire obligates or heavily favoured by fire (Buddle et al., 2006; Hyvärinen et al., 2006). These organisms require the burned dead trees found after fire and occur at much reduced numbers after forest salvage operations (Schmiegelow et al., 2006). Zackrisson et al. (1996) assert that the charcoal of burned snags promotes ecological processes that have important consequences for stand productivity and ecosystem function.

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

The RONV for different-age forests for the Moist Interior Plateau and Moist Interior Mountain Natural Disturbance Subunits (NDS's) was adopted for forests within the the SBS and ESSF forests BGC zones, respectively within the BLCF, respectively, as they fit the disturbance cycle and landscape conditions described for these NDS's in DeLong (2011). The RONV for these subunits was established using the estimated stand replacement disturbance cycle and a simulation model. The disturbance cycle (i.e., inverse of disturbance rate [% of total forested area per year × 100]) for these NDS's was obtained directly from DeLong (1998). Once a disturbance cycle was assigned to the NDS, the RONV for each age class was estimated using a simple stochastic landscape model implemented in SELES (Spatially Explicit Landscape Event Simulator) (Fall & Fall, 2001). The model was run for 1000 years to allow the disturbance regime to reach an equilibrium. The model was then run for another 1000 years and the lowest and highest value for each age class was used to characterize the RONV.

Different strategies for management of old forest are recommended for an NDS depending on the natural disturbance cycle and the historical, temporal, and spatial distribution of old forest.

In landscapes with high natural disturbance rates (e.g., disturbance cycle < 150 yr), such as the SBSdk and SBSdw3, even-aged stands, generally < 140 yrs old, dominate the landscape and patches of very old forest (> 200 yr) are rare. In such landscapes a strategy employing "rotating reserves" is recommended. In this strategy, large patches (> 100 ha) of older forest are identified to fulfil a percentage (e.g., > 50%) of the total old forest requirements. These reserves would be scheduled for harvest when reserve area(s) of roughly equivalent value and size have been identified to take their place. Reserve value would be based on factors including age, whether the stand resulted from a natural or managed disturbance (i.e., ones from natural disturbance would have higher value since they would contain natural levels of snags and CWD), and distance from major roads. The intent is to always have some large reserves of forest that are old but not so old (e.g., > 200 yr old) as to be "unnatural" and highly susceptible to stand replacement forest insect or disease outbreaks. Whenever possible the reserves chosen to replace existing ones should be stands that originated from a natural event (e.g., wildfire) that occurred in a natural stand. Such stands are more likely to contain higher levels of deadwood and be structurally more complex than managed stands. This is the seral stage management strategy that is recommended to be adopted for the SBSdk and dw3 within the BLCF and in particular for stands dominated by lodgepole pine as they are most susceptible to very high mortality of the main canopy as they age. Stands of mixed hybrid spruce and subalpine fir within the SBSdk and dw3 could be managed as permanent reserves as they are less susceptible to forest insect and disease outbreaks which result in very high mortality of the main canopy. These forest types would fit well in to a landscape connectivity strategy.

In landscapes where large fires were less common (e.g., disturbance cycle 150–300 years), stands that exceed 200 yrs are fairly common and more uneven-aged stands are present. In these landscape, a strategy of irregularly dispersed large permanent reserves is recommended. This may result in some areas (e.g., watersheds) having a large amount of old forest reserve and adjacent areas with much less. This strategy approximates the natural condition, in these landscapes, where at any one time a large fire may have consumed most of the forest in one watershed, while in an adjacent watershed much of the forest may have escaped fire for over 150 years. The more uneven-aged old forests in these landscapes are less susceptible to pest outbreaks, due to uneven susceptibility of trees in the stand, and thus have a higher likelihood of maintaining old forest structure over a long time. Replacement may be necessary but not continuously, as in the rotating reserve strategy. This is the strategy recommended for the SBSmc2 and ESSF forests within the BLCF, but it is recommended that management of the patches occur across a much larger area such as the whole NDS or the Timber Supply Area (TSA). This would allow for flexibility in management focus such that some areas of the TSA would have more reserve area (e.g., areas with important wildlife or scenic values) and others less.

Young natural forest is more difficult to manage since it is hard to predict when, where, and how much young natural forest will be created on the landscape. Currently in the BLCF, there are unsalvaged MPB stands that could be left as is. Stands with a component of spruce and subalpine fir would represent a lower fire threat as the fuels underneath are partially shaded. In stands that are purer lodgepole pine, prescribed burns may be feasible or, if they are burned by wildfire, just simply left unsalvaged.

Achieving the levels of old forest and young natural forest that were present in the natural landscape is not possible when forest products are being extracted from them so a balance between harvest and maintenance must be achieved. It is recommended that a target be determined for the amount of natural forest area (NFA) to be retained in each NDS. This could be determined for the TSA or for just the BLCF but larger areas allow for greater flexibility in achieving a target. The precautionary principle would suggest that the target for NFA be at least 70% of the minimum RONV. It is recommended that a total NFA target be determined but allow flexibility as to the amount of different age classes. Some minimum amount of old forest (>140yrs) is suggested.

Intensive forest management may be used as a tool to increase the area available for maintaining natural forests by reducing the land base required to achieve a desired harvest yield. Any strategy that can improve the volume yield for particular sites means that a desired harvest level can be achieved from a smaller land base, resulting in more area that can be used to protect natural forest values. This strategy has particular merit for high productivity sites along major access roads. The biodiversity value near roads is generally lower due to human access, noise, dust, etc.

3. Patch Size Management

Estimates of the patch size of old forest in natural landscapes have been shown to be heavily skewed to patches larger than 200 ha (Andison 2003). Studies of American marten and woodland caribou indicate that they prefer landscapes with some large patches of mature forest (i.e., > 200 ha) (Chapin et al., 1998; Courtois et al., 2008). In portions of the BLCF such as the northwest portion, where a high proportion of the landscape has been harvested, larger old forest patches are uncommon. In these areas, the priority should be to maintain any existing old forest patches and identify potential large recruitment patches as quickly as possible. The recruitment patches should preferably have <50% Pl in the canopy and be between 80 and 120 yrs. In other portions of the BLCF, such as between Tchesinkut Lake and Burns Lake, there is extensive areas of mid-aged natural forest. In these areas, there is more flexibility to identify recruitment areas that serve a multitude of values.

In areas of existing smaller harvest blocks designing a larger opening that encompasses these blocks while maintaining a relatively high level of retention (i.e., >10% of the total opening) may allow for retention of a large NFA somewhere else on the landscape.

4. Deciduous Management

Management of deciduous species has been suggested as one of the surrogates for the management of habitat for wildlife species (Bunnell et al., 1999). Mature aspen is a preferred tree for woodpeckers in central BC (Martin et al., 2004). Parsons et al., (2003) found that natural cavities in old aspen were important as maternal roost sites for bats in north central BC. Pojar (1995) found that aspen in sub-boreal forests was important for breeding bird communities in all seral stages and that mixed aspen conifer stands had higher species abundance and diversity than pure mature or old aspen stands.

As part of the overall strategy of maintaining NFA's, stands of aspen and mixed aspen-conifer should be identified and included in all seral stages. During harvest some larger mature patches of aspen or mixed aspen conifer could be left as wildlife tree patches but some should also be harvested and allowed to come back as young seral stands in order to ensure representation in all seral stages.

5. Connectivity and Riparian

Old forest connectivity in forests relatively unaffected by man's influence would have varied according to the periodicity of stand replacement events. In wet climatic regions old forest (i.e., >100 years) would have dominated the landscape such that there was almost continuous connectivity only broken up by topography (e.g., rock outcrops, rivers) or other non-forested types (e.g., subalpine meadows, unforested wetlands). In drier regions, stand replacement events (primarily wildfire) would have been common and often very large (> 10 000 ha). These fires would often burn through riparian areas with varying impacts. The riparian areas could be burned as severely as adjacent upland forest (Agee 1998). Remnant old forest was only slightly more common in riparian areas then other landscape positions in sub boreal forests near Prince George BC (DeLong, unpublished data). Large wildfires even burn peatlands in the boreal forest (Zoltai et al.. 1998). The burning of all forest types is seen as a rejuvenation process resulting in vigorous early seral vegetation that turns over leaf matter quickly and builds back nutrient reserves in the soils, so it is seen as a major soil-forming factor (Certini 2014). Fire also rejuvenates older plants such as shrubs such as willows and trees such as cottonwood in riparian and upland forests.

Based on the above, a landscape connectivity matrix (LCM) over the SBS portions of the BLCF should not be considered as a reserve but as a zone of management where harvesting or prescribed burning could occur. This would allow the important rejuvenation that occurs from disturbance of the matrix in the absence of natural disturbance. The onus of management in riparian zones should be on machine buffers or low ground pressure equipment especially in areas of wet, compactible or erodible soils. Limiting stream crossings and road edge near the LCM would reduce the many negative effects associated with them. Limiting human access through and within the LCM will allow safer passage for wildlife throughout the LCM.

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