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PROJECT SUMMARY

The ecosystem management component of the Morice & Lakes IFPA has embarked on several projects that assess biodiversity, ecological attibutes, and fish and wildlife habitat. These projects will provide important ecological data that will be used in learning scenario development for the IFPA's Sustainable Forest Management Plan.

A Comparison of Coarse Woody Debris in Harvested and Unharvested Sites

Ecosystem Management

Forest Productivity

Public Involvement

Adaptive Management

Introduction

Although forest dead wood has often been viewed as a nuisance and sometimes as a safety concern, the value of deadwood resources has long been recognized by forest ecologists and wildlife managers. In 1995, the Forest Practices Code Biodiversity Guidebook identified coarse woody debris (CWD) as an important stand attribute and a critical component of stand-level biodiversity. In 2000, the B.C. Ministry of Forests released a short-term strategy for managing CWD in operational forest harvesting.

The biodiversity management approach used in the FPC Biodiversity Guidebook assumes that "all native species and ecological processes are more likely to be maintained if managed forests are made to resemble those forests created by the activities of natural disturbance agents such as fire, wind, insects and disease." A preliminary step in managing for CWD is therefore to compare characteristics of CWD in unharvested stands with stands that have been recently harvested under the current management regime. This will identify characteristics that differ and help to determine where management efforts should be focused.

Objectives

The goal of this project is to devise a strategy to manage CWD across the Morice and Lakes Forest Districts, in a way that maintains naturally occurring processes and conditions, in accordance with the FPC Biodiversity Guidebook. The specific objectives of this report are:

- to describe CWD occurring in recently harvested and unharvested forests of the SBSdk, SBSmc2 and ESSFmc biogeoclimatic subzones in the Morice and Lakes Forest Districts; and
- to relate this, as far as possible, to known operational and ecological processes and conditions.

Methods

We surveyed 102 recently-harvested cutblocks in the three major subzones of the Morice and Lakes Forest Districts. All these blocks were clearcut, with or without reserves. In each block, we established several plots to measure the following CWD attributes:

- species
- decay class
- diameter
- length class
- tilt angle
- height above ground

We established similar plots within Wildlife Tree Patchs (WTPs), and also tallied residual and immature live trees remaining on the block outside a WTP.

We compared data collected from cutblock plots to data collected from unharvested WTP plots and also, where possible, to a much larger dataset containing 1695 plots compiled from various sources in mainly unmanaged sites in the SBSdk, SBSmc2 and ESSFmc. These data are discussed separately in Lloyd (2001).

Results

Overall, mean CWD volumes in harvested areas are somewhat higher than in unharvested areas in the ESSFmc, somewhat lower in the SBSmc2 and about the same in the SBSdk. However, CWD pieces in harvested areas are smaller and much shorter than those in unharvested areas regardless of subzone. Over half the volume (56%) in unharvested areas comes from pieces over 10m long; in harvested areas, this is about 11%. Diameters are also smaller in harvested areas. There are also many more pieces in harvested areas, but many are less than 2.5m long and nearly all are less than 10m long (Figures 2 and 3). In addition, most post-harvest CWD is decay class 2 or 3 (see sidebar page 3) and lies flat on the ground—there is very little that is either sound or very rotten (class 1 or 5) and is elevated off the ground.

Factors affecting post-harvest CWD

The amount of CWD present after harvest depends in part on stand composition and site productivity. Stands that were primarily balsam (subalpine fir) have higher CWD volumes than those which were primarily pine or spruce, and moist, rich site series have higher CWD volumes than dry or poor ones (Table 1). Post-harvest CWD can also be related to the potential dead wood present prior to harvest – as snags, cull trees and the estimated "decay, waste and breakage" portion of live tree volume identified in the timber cruise (correlation coefficient $r = 0.71$). Generally, pre-harvest dead wood is also higher in balsam-leading stands than in pine or spruce.

Stand age affects CWD volumes (e.g. Lofroth, 1998; Lloyd 2001). Most stands were age class 7-8 (120-250 years old) at the time of harvest.

Operational factors also affect CWD. Mean CWD volumes are about 30% higher after winter logging than after summer harvest. Much of this difference is due to a lack of very soft (class 5) CWD, which is protected by deep or packed snow in winter but can be destroyed by heavy equipment traffic during summer harvest. Harder (class 2-3) CWD is frequently damaged, especially after summer harvest, but is rarely destroyed. Mechanical site preparation has a similar impact.

Snags and residual live trees

We found no snags in harvested areas outside WTPs. Most cutblocks had less than 2 residual live trees per ha. (7.5cm diameter or larger), although stands with a deciduous component prior to harvest often had more (as residual aspen).

Table 1. *Mean CWD volumes in harvested and unharvested sites.*

leading tree species	Mean CWD volume (m3/ha.)					
	SBSdk		SBSmc2		ESSFmc	
	unharvested	harvested	unharvested	harvested	unharvested	harvested
Bl leading	-	-	203	144	150	210
Pl leading	49	76	92	107	79	90
Sx leading	65	42	128	133	131	-
all spp.	64	74	152	110	113	151

Discussion

CWD levels fluctuate over the life of a stand. In unmanaged stands in the SBS, where the mean fire return interval is about 125 years, CWD levels are at their highest soon after fire or other disturbance, when snags and dying trees have fallen (Figure 1). These logs decay as the stand regenerates, but there is no new input until the "young forest" stage, when self-thinning begins to cause mortality of suppressed trees. CWD volumes are at their lowest at this point, and consist mostly of soft, decaying wood. CWD input increases from this point, both in overall volume and in the size of individual pieces (as the size of trees in the live stand increases), until the next catastrophic disturbance (Stevens, 1997; Lofroth, 1998).

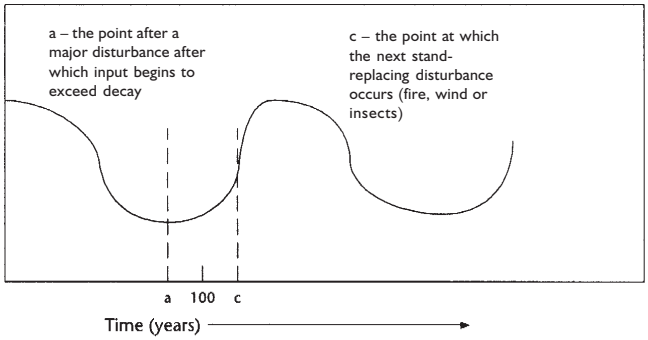

***Figure 1**. Changes in CWD volume over the life of an unmanaged stand in NDT3[1]*

This study shows that in a managed stand, CWD volumes after harvest are at or fairly near the mean volume for similar stands across their lifetime. However, the volume peak that occurs in an unmanaged stand after disturbance will not occur in a managed stand, because there are no snags or dying trees still standing. The rate of decay will be faster in a managed stand, because the pieces are smaller and therefore decay more rapidly, so CWD volumes are expected to be much lower than average by the mid seral stages. Whether input from self-thinning occurs will depend largely on the stem density of the regenerating stand. Input from larger trees toward the end of the stand's life will depend on rotation age, and the presence and availability of large or cull trees that could contribute to CWD. The presence of large trees at the end of the regenerating stand's life will likely depend on whether they were present as legacies from the previous stand (i.e. as post-harvest residual live trees).

Piece size (length and diameter) and decay class vary markedly between harvested and unharvested stands, with harvested areas having smaller and much shorter pieces representing mainly decay class 2-3. Bull et al. (1997) reported that size, distribution and orientation of logs were more important to wildlife than tonnage or volume. The preponderance of small, short pieces may have particular impact on species that use a log because of its physical structure rather than as a growing substrate or food source. For instance, small mammals use logs extensively as runways, but the small post-harvest pieces do not

About decay classes

Fallen trees pass through a series of five classes as they decay, from sound wood to a reddish-brown powder not easily distinguishable from the soil.

Class 1 represents sound wood, probably from recently fallen green trees or sound snags. It has branches and bark intact, is supported off the ground and provides shelter, foraging opportunities and subnivean access for various wildlife species.

Class 2 represents mostly sound wood, with intact or flaking bark, but is sagging or on the ground. It provides shelter, forage and travel routes for wildlife (particularly small mammals) and can be colonized by invertebrates such as wood-borers and ants.

Class 3 represents partly decayed wood which lacks bark and branches, and may be starting to break up. It provides shelter and travel routes for amphibians and small mammals, and is home to an increasing number of invertebrates. The sapwood is softening and plant roots may be invading.

Class 4 represents decayed wood which is brownish and often has a blocky texture. It is soft and can be burrowed into by many insects and small mammals; invading plant roots reach the heartwood. Some plants require decayed logs for seedling establishment, especially in wet areas.

Class 5 represents decayed wood that is soft, brownish and has a fibrous to powdery texture. It is generally partly buried in the forest floor where it provides a moist microsite for invertebrates and herpetiles that cannot tolerate dry conditions. Small mammals and herpetiles can make protected dens and burrows in the soft interior of the log. This stage can persist for many years.

Figure 1. Pre-harvest CWD: pieces are comparatively long, fallen in a criss-cross pattern so that some are elevated off the ground. Log size reflects tree size in the surrounding live stand.

Figure 2. Post-harvest CWD: pieces are small and short, and most lie directly on the ground. There are no remaining snags or large green trees, and few residual live trees for CWD recruitment.

form the network of runways encountered in pre-harvest stands. Ant colonies are more commonly found in larger, longer logs – carpenter ants are particularly associated with large-diameter pieces (Torgersen and Bull, 1995) – and smaller logs may simply not have room to accommodate larger colonies. Logs supported off the ground (decay class 1-2), especially patches of such logs, provide cover for small mammals and are used as hunting grounds for marten, mink and cougar (Bull et al., 1997). They are also preferred breeding areas for lynx (Koehler and Aubry, 1994) and provide an array of subnivean spaces and runways required by small mammals and their predators in winter. Soft, decayed CWD (decay class 5) is used by specific communities of invertebrates (Harmon et al., 1986) and provides a stable, moist microsite for species such as amphibians, which cannot tolerate dry conditions.

Recommendations

These recommendations are based on the results of this study, and also on a CWD pilot study currently underway in the Morice Forest District as a cooperative project between Houston Forest Products Ltd. and the B.C. Ministry of Forests. A set of recommendations will be produced as a result of that study.

1. **Maintain larger, longer pieces of CWD in the best condition possible.**
- avoid skidding unwanted logs to the landing
- unwanted logs over 5m long should be kept out of burn piles – at the roadside/landing, put them on one side for return to the block if possible
- if an unwanted tree or snag is felled it should be placed in the direction of skid, to one side of the skid route if channelized skidding is used, adjacent to a stub or retained tree if possible
- all of the above applies particularly to anything that still has branches and bark

2. **Keep relatively sound logs off the ground as far as possible.**
- try not to disturb natural accumulations of downed logs
- if a tree or snag is felled and left, try to put it down across other logs
- avoid bunching groups of logs if they are not going to be skidded to the landing. If several unwanted snags are felled together and left in direction of skid, short logs work well as cross-pieces to maintain elevation and space between longer logs.

3. **Maintain snags and green trees for short-term CWD recruitment.**
- aspen and cottonwood should always be left standing
- maintain groups of snags either within no-work zones or in small WTPs. (There will be a trade-off between establishing large WTPs to minimize windthrow and fragmentation and establishing small WTPs as sources of snags and CWD within harvested areas.)
- a declining or cull tree of little commercial value should be left standing if it can be identified as such (either by the buncher operator or flagged during pre-harvest assessments)
- any snag that can be certified safe should be left. Large spruce snags are good candidates.

4. **Maintain immature trees for long-term CWD recruitment.**
- trees just under commercial size should be left standing (and undamaged) wherever possible. Immature spruce pole-size or bigger should always be left.

General:

- The most efficient means of maintaining intact pieces of CWD and larger immature trees is probably in patches (Photo 3 – groups). These are visible to equipment operators and can be avoided during harvesting operations, where isolated logs and trees usually cannot.
- Group retention tends to channelize skidding (around the groups) and is therefore not suitable for sites with easily-disturbed soils.
- The outside edges of groups are prone to damage from passing skidders. Stubs retained around the edge of the group reduce damage to the group interior.
- A single stub can act as a "group marker" for two or three logs left in direction of skid at its base.
- Group locations can be determined by the buncher operator depending on the location of suitable areas of snags, blowdown and/or understory trees, or could be concentrated in special management zones such as Riparian Management Areas.

Figure 4. Group retention of CWD and larger immature trees. Ground skidding is localized around retained groups, which are marked by stubs and/or large immature trees to enhance their visibility to equipment operators during harvest. (Photo courtesy of HFP/MOF Interior CWD pilot study.)

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