



## PROJECT SUMMARY

Ecosystem  
 Management

Forest Productivity

Public Involvement

Adaptive  
 Management

The ecosystem management component of the Morice & Lakes IFPA has embarked on several projects that assess biodiversity, ecological attributes, 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 (2002)



Fraser Lake Sawmills

### 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 (e.g. Maser et al., 1979, Maser and Trappe, 1984, Harmon et al., 1986). 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 and, 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 and in stands that have been recently harvested under the current management regime. This will identify characteristics that differ and thus help to determine where management effort should be focussed.

### Goals and 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 145 recently harvested cutblocks in the three major subzones of the Morice and Lakes Forest Districts. All of 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 Patches (WTPs), and also tallied snags, stubs 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 1659 plots compiled from various sources in unmanaged sites in the SBSdk, SBSmc2 and ESSFmc. These data are discussed separately in Lloyd (2001).

### 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 which 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.

## Results

Overall, CWD volumes in harvested areas are somewhat higher than in unharvested areas in the SBSdk, somewhat lower in the SBSmc2 and about the same in the ESSFmc. However, CWD pieces in harvested areas are smaller and much shorter than those in unharvested areas regardless of subzone. Over half the volume (55%) in unharvested areas comes from logs over 10m long; in harvested areas, this is about 10%. (Figure 3). There are many more logs in harvested areas, but most are less than 2.5m long and nearly all are less than 10m long (Figures 1 and 2). Diameters are also smaller in harvested areas. In addition, most post-harvest CWD is decay class 2 or 3 (see sidebar) 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.



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 long-term CWD recruitment.

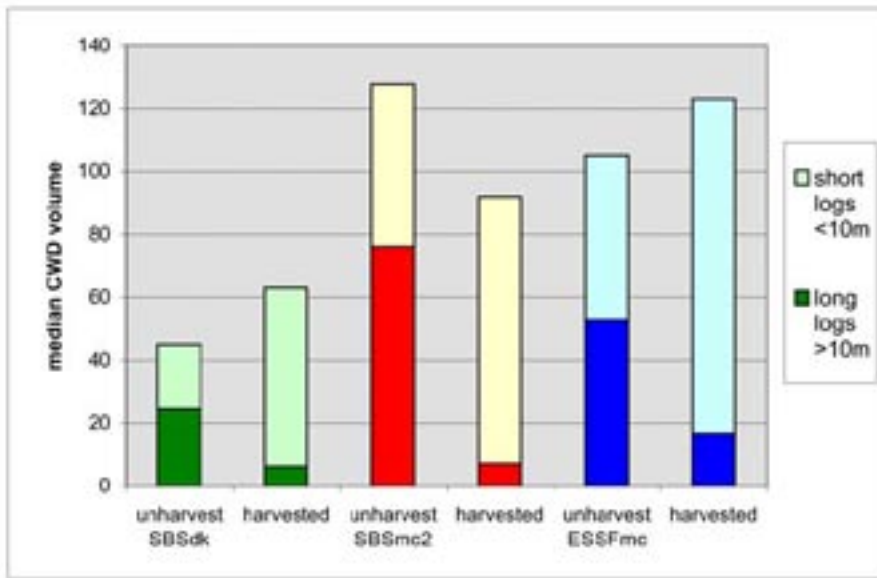


Figure 3 Comparative volumes of short and long logs in unharvested and harvested areas

### Factors affecting post-harvest CWD

The amount of CWD present after harvest depends in part on stand age, composition and site productivity. Older stands, particularly those over 250 years old, produce more CWD after harvest than do younger ones. Stands that were primarily balsam (sub-alpine 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  $r = 0.64$ ). Generally, pre-harvest dead wood is also higher in older stands, more productive stands, and stands that are balsam-leading rather than pine or spruce.

Median values are shown because CWD volume distributions are strongly skewed to the low end of the scale – that is, most plot volumes are considerably less than the mean volume.

Operational factors also affect CWD. 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.

Table 1. Median CWD volumes in harvested and unharvested sites

Stand age/ composition/ site series		Median CWD volume (m³/ha)					
		SBSdk		SBSmc2		ESSFmc	
		unharvested	harvested	unharvested	harvested	unharvested	harvested
age class (years)	>250	-	-	279	170	261	275
	140-250	82	70	195	105	96	134
	<140	48	65	153	95	74	61
leading species	BI	-	-	207	126	174	184
	Sx	50	43	71	99	125	-
	PI	38	64	62	85	73	75
site series group	Good	133	153	247	136	247	166
	Moderate	45	63	144	89	92	102
	Poor	35	63	74	82	60	63
ALL		45	63	128	92	105	123

### Snags, stubs and residual live trees

In the short term, CWD input in harvested stands will come from snags and mature green trees that fall over and are allowed to remain on site. In the long term, CWD recruitment is most likely to come from residual live trees that were immature at the time of harvest, but will be older and probably larger than planted stock at the end of the next stand's life.

Except for residual aspen, which occurred at low densities in the SBSdk, there were no standing snags or large green trees in harvested areas outside WTPs. Most cutblocks had between 3 and 30 live immature trees per hectare (>1.5m tall), and most of these were saplings (<7.5 cm diameter). This means that even if all residual immature trees grow to maturity and contribute to future CWD, there will be a very large shortfall in CWD recruitment in all subzones at rotation.

Sites that were mechanically prepared for planting had a much lower density of residual immature trees. In gullies and designated Machine Free Zones (MFZs), immature tree densities were 15-50 times higher than on the rest of the cutblock. Damage and disturbance to existing CWD was also less in MFZs, making them the best source of structural retention outside WTPs.

### 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 4). 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).

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; and input from larger trees toward the end of the stand's life will depend on whether large or cull trees exist and could contribute to CWD. The most likely source of large or cull trees is residual live trees, which will grow to be larger than planted trees by the time of next harvest, but at present there are not enough of these to maintain current CWD levels.

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 form the network of runways encountered in preharvest 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.

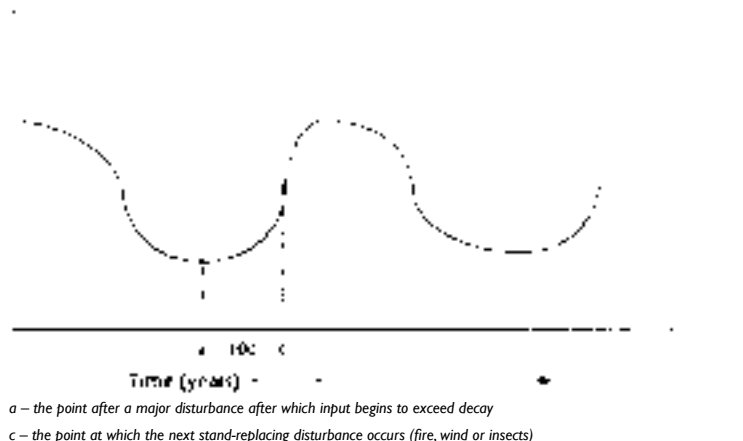


Figure 4. Changes in CWD volume over the life of an unmanaged stand in NDT3<sup>1</sup>

<sup>1</sup> From Stevens (1997), page 14, figure 5

## Recommendations

The primary recommendations from this study are:

### **1. Maintain the 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 the 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 which are just under commercial size should be left standing (and undamaged) wherever possible. Immature spruce pole-size or bigger should always be left.

## Further Recommendations: Clumped retention of structural elements

The most practical way of retaining structural elements such as CWD, stubs and live trees undamaged is in clumps that are easily visible to equipment operators during harvest and can therefore be relatively easily avoided (Photo 3). The following recommendations are based in part on the results of this project, and partly on a CWD pilot study undertaken as a cooperative project between Houston Forest Products Ltd and the B.C. Ministry of Forests (Lloyd, in prep):

### **1. Location**

- Clumps can be located almost anywhere on the block, but it is most efficient to base them around existing clumps of immature, deciduous or other unmerchantable trees, blowdown patches or groups of stubbed snags (Photo 4). Clumps could also be concentrated in special management zones such as Riparian Management Areas.
- After appropriate training, actual location of clumps is probably best decided in the field by the feller-buncher operator, as he is best acquainted with the use and limitations of his machine.
- Site preparation can destroy inappropriately-located clumps. Either clumps should not be located in areas that require mounding or disc-trenching, or these activities should avoid clumps. Burn piles, including roadside piles, should be located far enough away (>10 m, depending on the size of the pile) to avoid heat damage to residual trees.
- Structural retention in clumps tends to channelize skidding (around the clumps) and is therefore not suitable for sites with easily-disturbed soils.

### **2. Composition**

- The outside edges of clumps are prone to damage from passing skidders. Stubs retained around the edge of the clump reduce damage to the clump interior.
- Placing logs within clumps tends to damage any residual trees growing there. If a log (felled snag or stub top) is added to a clump with residual live trees, it should be placed around the edge, in direction of skid.
- A single stub can act as a “clump marker” for two or three logs left in direction of skid at its base.
- As it is impractical to retain all structural elements, prioritization is strongly recommended e.g. long logs > large immature trees > short logs > small immature trees



Figure 5. Clumped retention of CWD and larger immature trees. Ground skidding is localized around retained groups, which are marked by stumps and/or large immature trees to enhance their visibility to equipment operators during harvest.



Figure 6. Using existing immature trees as a base for a clump. A group of larger immature trees provide the basis for a clump. Unwanted felled snags are placed alongside the clump, in direction of skid to minimize skidder damage. A stub at the outer edge of the clump provides protection to the interior of the clump ("rub tree").

(Figures 5 and 6 courtesy of HFP/MoF Interior CWD pilot study.)

## Acknowledgements

This project was initiated by Houston Forest Products Company (HFP), in accordance with Weldwood of Canada's Environmental Stewardship Policy. It was undertaken primarily by Ruth Lloyd, with direction from Melissa Todd (Senior Biologist, HFP). The project was expanded to cover the Morice and Lakes Forest Districts, and funding has been provided by the Morice & Lakes Innovative Forest Practices Agreement (IFPA) through Forest Renewal B.C. in 2001, and Forest Investment Account (FIA) in 2002. Licensees signatory to the IFPA include Houston Forest Products, Canadian Forest Products (Canfor), Babine Forest Products and Fraser Lake Sawmills, all of whom have generously contributed time and resources in locating study areas and providing maps and ancillary information. Additional data were kindly provided by Babine Forest Products and the Northern Interior Vegetation Management Association (NIVMA).

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