

Variable Retention Implementation Monitoring on Weyerhaeuser's British Columbia Coastal Timberlands

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Abstract

Variable retention (VR) is both a tool for achieving stand-level objectives and an important strategy for achieving forest-level goals, such as conservation of biodiversity. Weyerhaeuser's BC Coastal Timberlands is implementing an innovative forest management strategy that includes the use of landscape zoning, variable retention and adaptive management to balance ecological, social and economic objectives.

As part of the adaptive management program, operational implementation was monitored to see if the goals and standards established for VR were being met. Implementation monitoring is an essential part of effectiveness monitoring; there is little point in monitoring effectiveness if you do not know what was actually done. Symmetree Consulting Group completed evaluations on 248 VR cutblocks from 1999 through 2003, representing a random sample of 17% of all VR harvesting. Results were communicated to field foresters to provide for continuous improvement of VR layout and to managers to facilitate adjustments to company policies.

This paper presents a summary of the methods and findings of the implementation monitoring program. Statistics were compiled on the amount and type of retention, size of groups, type of stand attributes and ecological features retained, protection of small streams and riparian areas and the visual aesthetics of the block design. Each block was scored based on the degree to which it met the goals for variable retention. Overall, variable retention was implemented to the levels and standards set out in Weyerhaeuser's BC Coast Forest Strategy guidelines.

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Introduction

In November 1997, the Chief Executive Officer of MacMillan Bloedel (which became part of Weyerhaeuser in 1999) commissioned a comprehensive review of the company's forest policies in its coastal B.C. operations (Dunsworth and Beese 2000). This initiative emerged from a desire to maintain the "social license" to practice forestry in B.C. by fostering healthy relationships with customers, shareholders and the public. The review concluded that traditional clearcutting approaches to management of forest land were no longer meeting public expectations.

A group of specialists known as the "Forest Project" team developed a forest stewardship program that was announced publicly in June 1998. The key elements of the program were to define broad management objectives for landscape zones, adopt an ecologically based approach to harvesting and silvicultural systems known as variable retention, increase conservation of old-growth forests and achieve independent forest certification.

The five-year implementation phase of the Forest Project was successfully completed in 2003. Implementation monitoring through this phase helped ensure a consistent approach to variable retention practices, allowing for more meaningful effectiveness monitoring over time. The company renamed this program the "BC Coast Forest Strategy" and has developed an adaptive management approach to achieve their ecological objectives. The program is described fully at: www.forestry.ubc.ca/conservation/forest_strategy.

Goals of Variable Retention

The term variable retention (VR) was first introduced by the Clayoquot Scientific Panel (1995) and was subsequently described in a broader context by Franklin et al. (1997). Mitchell and Beese (2002) further described VR as a conceptual "approach" to silvicultural systems and defined the "retention silvicultural system" as the primary method for accomplishing VR. Variable retention follows nature's model by retaining part of the forest after harvesting, recognizing the role of structural complexity to forest ecosystem function and biological diversity (Bunnell et al. 1998).

Various levels of retention can be used with different types, amounts and spatial patterns of structure. Retention can be dispersed throughout a cutblock (individual trees or small groups) or aggregated (larger groups) depending upon the objectives. For safety, economic and ecological

reasons, group retention is often preferred; however, intentional variability is a key goal. Because no single pattern is optimal for all species, opportunities for dispersed retention are important.

The specific goals for Weyerhaeuser's variable retention approach in coastal BC are:

- A. To leave a biological legacy of old-forest attributes, well distributed within each stand and over the landscape, to maintain biological diversity within Weyerhaeuser tenures. The general intent of this goal is to enrich the structural diversity of second-growth stands, enhance habitat connectivity over the landscape, and provide "lifeboats" for survival and dispersal of species after harvesting (Franklin et al. 1997).
- B. To ensure that each cutblock maintains *forest influence* on the majority of the block, thereby distinguishing it ecologically from a *clearcut*.^a Along with distribution of attributes, forest influence defines the retention silvicultural system.
- C. To ensure that each cutblock will be viewed by the public as an example of forest stewardship. The intent is to meet social expectations of stewardship and visual aesthetics by creating opportunities to harvest without high-grading or compromising worker safety, forest health, vigor, genetics or timber quality.

Forest or residual tree influence is defined as the biophysical effects of forests or individual trees on the environment of the surrounding land. The degree, type, and distance of influence can vary widely; however, within and adjacent to harvested areas, most forest edge and residual tree influences begin to diminish significantly at distances greater than one tree length from a standing tree, group of trees, or forest edge (Keenan and Kimmins 1993). Although forest influence has been defined as one tree length for simplicity, we recognize that specific influences vary by species, aspect and slope, and single trees do not have the same influence as groups or stand edges (Beese et al. 2003).

To simplify the operational implementation of the retention system, Weyerhaeuser guidelines emerging from the three VR goals state that retained groups of trees should be 0.25 ha or larger in size and no more than four tree lengths apart. Individual trees or smaller groups should be no more than two tree lengths apart; consequently, no place within a cutblock is more than two tree lengths from some standing trees (Zielke and Beese 2004). These guidelines are flexible, but they ensure that retention is well distributed within a cutblock and that the forest influence criteria are achieved. The minimum group size ensures that understory habitat attributes are retained, such as undisturbed shrubs and mosses, and allows retention of dead trees with an unharvested buffer around them for worker safety.

Variable retention silvicultural prescriptions must address three important questions: what structures to retain, how much to retain and what spatial pattern of retention to use (Franklin et al. 1997). The choice of approach depends on both the specific stand-level objectives for retention and how the cutblock contributes to landscape-level management objectives. Prescriptions must also consider a host of factors such as safety, ecological values, silviculture, harvesting feasibility, economics and visual aesthetics.

The common harvest design approach is to conduct a reconnaissance survey of a proposed cutblock to map the location of biological control points or "anchors" (Beese et al. 2003). These consist of key features that are important for meeting either specific or broad goals for retention. Biological anchors may include: riparian areas or rock outcrops; dead standing trees (snags), trees with decay features, coarse woody debris; patches of live trees representing a range of tree sizes, species and multiple canopy layers; large "veteran" trees and trees with dens or nests;

gullies, seeps and other unique flora or terrain features. Capturing rare features, ensuring representation or meeting requirements for species of concern may all influence what to retain.

Biological anchors are mapped and integrated with common engineering control points to allow for an optimal design for biological diversity, logging efficiency, visual aesthetics and timber management objectives for regeneration, forest health and other issues. In some areas additional objectives are integrated into the final design.

Objectives and Methods for Variable Retention Implementation Monitoring

The multi-year evaluation of variable retention (VR) blocks was conducted for several reasons:

1. To provide feedback to operations to advance learning and implementation of variable retention.
2. To collect data as part of Weyerhaeuser's adaptive management implementation monitoring program.
3. To ensure that the blocks reported as "VR blocks" indeed meet the goals of variable retention and the specific criteria for the retention system.

Each year the blocks to be assessed were randomly selected from a list of VR blocks reported by the Timberlands units for that year. The number of blocks sampled was determined based on the size of the unit and its annual harvest. Generally 5 to 12 blocks were examined in each unit, providing a total of 248 blocks (7155 ha) over the 5-year (1999-2003) phase-in period (Bancroft and Zielke 2004). This sample represents 17% of the total blocks harvested during the phase-in. It also included data for over 1500 groups and for retention on over 150 km of small in-block streams.

The blocks were evaluated in the context of the company's goals for variable retention. The three goals were translated into a set of indicators with corresponding performance criteria to allow scoring each block in one of five performance categories. Performance categories were: *Excellent, Good, Acceptable, Questionable* and *Does Not Meet VR Goals*.

Each block was specifically evaluated by:

- o Discussing implementation issues and learning experiences (as much as possible) with those involved in prescriptions, layout and harvesting;
- o Making observations and recording data and notes for each retained group; assessing dispersed retention within the whole block or, where this was not practical, sampling a representative portion of the block;
- o Estimating forest influence where it was clearly beyond the required 50%; when forest influence appeared close to the required 50%, a rough calculation was used to determine the influence using estimated height from edge segments of edge and individual trees;
- o Recording observations relating to harvesting and stewardship issues such as safety, high-grading and forest health;
- o Recording general lessons from the cutblocks that could be used by others when developing prescriptions or plans for variable retention.

Five-year Results of Monitoring

The goal for the five-year phase-in period was to increase the proportion of VR by 20% per year until all harvesting within Weyerhaeuser's BC Coastal tenures was done using VR by the end of 2003. The amount of VR exceeded the annual targets for the first four years. Over 90% of all harvesting was done with VR in 2003; the shortfall from 100% resulted mostly from deferrals in contract logging operations and the carry-over effects of salvage from a 40-year storm in December 2001. The total amount and percentage of VR over five years actually exceeded the goal. Overall, implementation of VR was done in a safe and cost-effective manner.

Overall performance ratings

Most of the VR harvesting evaluated met the three goals of VR and were considered *Good* or *Excellent* examples (61 to 75% of total harvested area). Each year had some *Excellent* examples of VR, ranging from 10 to 20% of the area sampled.

Generally, harvesting on terrain steep enough to warrant cable yarding made it more difficult to achieve a *Good* or *Excellent* result. This was not always the case, but greater complexity of terrain limits the options available for grapple yarding (the preferred cable harvest method), making it more challenging to meet VR goals. Blocks harvested with ground-based hoe-chucking^b tended to meet a *Good* or *Excellent* VR rating relatively easily.

There were a few blocks each year (5 to 10%) that were rated as *Questionable* examples of VR. *Questionable* ratings were assigned either because forest influence was near or slightly below the 50% minimum, or the retention was not well distributed within the block. Some blocks were designated by the Timberlands unit as VR but when assessed in the field failed to meet the three goals. The number of blocks in this category was normally small (1 to 3%). When considered together, *Questionable* plus *Not VR* generally accounted for 8 to 11% of the area assessed.

Amount and pattern of retention

The average amount of block-level retention over the five-year period ranged from a low of 18% in both 1999 and 2003 to a high of 23% in 2001. Blocks classified as group retention had 1% to 7% more retention on average than blocks with a combination of groups and dispersed retention. In blocks where dispersed retention dominated, retention levels were the lowest at 5 to 10% of the original basal area.

Groups ranging in size from 0.25 ha to more than 5.0 ha dominated the retention over the five-year period. Most blocks had some dispersed retention combined with the groups, contributing positively to the VR visual objectives while adding to the structure and species diversity found on site. Through all five years the amount of retention exceeded that required by provincial legislation by 10 to 15%.

The amount of retention left on multi-entry blocks varied considerably over the sample period, ranging from 24 to 69% above the level required by the BC Forest Practices Code. The main reason for using multi-entry systems was to meet provincial adjacency regulations^c. In some cases, blocks were planned for multiple entries where portions of the block had not yet achieved merchantable sizes or to better meet local visual quality objectives.

The blocks sampled covered the range of harvesting systems in use. Hoe-chucking was the most common system—used on one half to two thirds of the total area sampled. Grapple yarding with a swing yarder crane was used on 25 to 30% of the sample area, followed by helicopter yarding (5 to 13%).

Retention quality

In each annual assessment, retention was found to provide a range of structure: both a variety of group sizes, and a range of species and sizes of individual leave trees. The utilization of biological anchors was successful in retaining less-common tree species assemblages, riparian areas with associated terrestrial riparian habitat, unique or less-common understory plant communities, snags and veteran trees. Most groups had some wildlife trees with moderate to advanced decay (63 to 80% of all groups).

Deciduous retention was well utilized (7 to 11% of groups) wherever it was found, emphasizing its importance to bolster the short-term supply of soft snags on the landscape. As deciduous trees are often shorter-lived than conifers, use of deciduous trees within groups may over time result in gaps that will encourage varied structures.

In many cases matrix retention^d was left to satisfy goals for quantity and distribution of retention. The mix of matrix and anchored groups provided a diverse array of structures over the landscape including a range of present and future habitats.

A concern expressed at the onset of VR implementation was that the more valuable tree species would be harvested leaving the lesser-valued species behind. Based on the five years of sampling, this was not found to be an issue. The species retained were for the most part representative of the pre-harvest stand condition across the various geographical areas.

A diversity of retained groups as biological legacies now exist within Weyerhaeuser VR blocks; more than 1500 of these groups were assessed. A broad range of group sizes was retained, from those less than 0.25 ha (mapped clumps) to larger groups over 5.0 ha. A trend for group size emerged over the five-year period: the proportion of groups between 0.5 and 1.0 ha increased, while the proportion between 0.25 and 0.5 ha declined. This trend likely reflects adjustments to practices from greater windthrow in smaller groups.

Retention on small streams

Riparian areas are critical habitat for a range of species. The provincial Forest Practices Code requires retention on larger fish bearing streams; however, smaller streams and wetlands, if they are associated with significant terrestrial riparian vegetation, may provide complex structure and more diverse plant communities than their upland matrix counterparts. With this in mind, layout crews consistently utilized riparian habitats and features to anchor retention, in many cases going beyond legislated requirements. In 2003, almost half of the groups had some form of riparian anchor or feature within them.

A total of 151 km of streams were found within the cutblocks assessed over the last three years, with 76 km having some level of retention associated with the stream and 51 km having a buffer of 20 m or more along both sides of the stream. An additional 42 km of streams were along block boundaries with 30 km having retention of 20 m or more buffering the stream.

Forest influence

The average forest influence was well above the >50% level required for the retention system, ranging from 68 to 79% over the assessment period. Nevertheless, within each sample year a subset of blocks had influence levels near or below 50%, prompting a *Questionable* or occasionally a *Not VR* overall rating. For those blocks bordering on recent logging, forest influence had to be achieved almost entirely from retention inside the block. This presented the biggest layout challenge for meeting this requirement.

Windthrow

Because the implementation evaluations often occurred within one year of harvesting, the full extent of windthrow was not apparent; however, most of the blocks viewed had experienced at least one winter with associated storm events. A range of windthrow was observed each year. In 2002, approximately 30% of the groups surveyed had some level of blowdown, ranging from 1% to 90% with an average of 17% for groups that experienced windthrow. In 2003, the proportion of groups that had some level of windthrow ranged from 6% to 54% depending on the geographical area, with an average of 36% for all areas combined.

When translated to a proportion of the total retained structure, windthrow ranged from 0.2% to 9% across all units. Windthrow levels in individual groups ranged from zero to 90%, with most groups having less than 20%. Rarely was 100% blowdown observed in a group, even after being exposed to catastrophic wind events^e.

Medium or larger group retention (0.4 ha or greater) seemed to provide the greatest potential for maintaining standing trees in areas of high windthrow potential (e.g., ridge tops facing prevailing winds). In some second growth stands, partial blowdown in groups may enhance structure by thinning—encouraging a greater variety of structures more quickly.

All Timberlands have identified windthrow as an ongoing issue and have implemented approaches to minimize it, or salvage it where possible. Weyerhaeuser has a separate monitoring program to specifically look at windthrow impacts over a longer time period (Rollerson et al. 2004).

High-grading

High-grading is a potentially serious concern for future options and sustainability where partial cutting is employed. Company guidelines clearly identify the requirements for stand attributes and regeneration after harvesting (Zielke and Beese 2004). These guidelines were used to evaluate whether high-grading occurred on the blocks monitored. While high-grading was not a problem in most of the blocks reviewed, it was a concern on a small number of blocks in the first sample year; it was not found to be an issue in subsequent years.

Forest health

Overall the main two forest health issues—hemlock dwarf mistletoe and laminated root rot—were identified prior to harvest, with well-designed strategies to address these pathogens over time. Approaches varied by Timberlands unit; however, there was an awareness in prescriptions that follow-up assessment and treatments must be diligently pursued.

Safe leave trees

Over the sampling period the issue of safe leave trees appears to have been addressed by the Timberlands operations through faller training and on-site discretion. Overall, most apparent danger trees were cut, leaving few trees with danger indicators on block or group edges. The company safety record actually improved through the implementation period, with no workplace accidents directly attributed to the use of variable retention.

Meeting visual goals

The majority of blocks viewed over the assessment period met the visual goal for VR. However, numerous blocks had portions that were deemed too open to meet this goal. Often the open areas were created due to logistical constraints such as steep, rocky ground. VR was found to be effective at breaking up sight lines and softening the look of harvesting when visual objectives were identified. Frequently, minor adjustments to layout and the inclusion of small clumps or a few large veteran trees made a significant difference to visual aesthetics.

Conclusion

At the inception of the Forest Project many concerns emerged that variable retention was not suited to Coastal British Columbia for a number of reasons including: windthrow, safety and the steep, rough terrain. Many thought the approach was a thinly veiled attempt to high-grade timber. Implementation monitoring of over 7000 ha found none of these concerns to be a serious impediment to the application of VR. Instead, clear goals, a well-designed strategy, cooperation, good communication and feedback allowed a range of forest structure to be efficiently maintained throughout Weyerhaeuser's tenures in Coastal BC without unduly compromising other resource management objectives. Implementation monitoring results showed that practices were largely applied as planned. With this knowledge and the associated database, effectiveness of the company's program for maintaining biological diversity can be assessed.

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Footnotes:

- a) Keenan and Kimmins (1993) state “the minimum size of opening that constitutes a clear-cut varies with the height of the surrounding forest, and is roughly equal to an area greater than about four tree heights in diameter.” The retention system, therefore, must maintain greater than half of the original forest area within the influence of surrounding trees, or trees retained within the harvested area, and create openings that are generally less than four tree heights across to be considered something different from clearcutting.
- b) Hoe-chucking – forwarding wood to roadside using an excavator equipped with a grapple (often the same equipment used to load wood).
- c) Adjacency Regulations – Includes requirements for visual green-up (height of regeneration) before adjacent cutting is allowed, and maximum cutblock size without specified levels of retention.
- d) Matrix Retention – Similar to most of the timber and ecosystems on the block before harvesting; no unusual biological features.
- e) Catastrophic windthrow - *Some cutblocks were evaluated north of Campbell River that had been exposed to a catastrophic wind storm in December 2001.*