Stand-Level Biodiversity Monitoring–An Evolving Approach

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ABSTRACT

The default practices for stand-level biodiversity under the Forest and Range Practices Act (FRPA) relate largely to areas of wildlife tree retention, with little direction on the type of structural attributes to be retained. In evaluating the effectiveness of stand-level biodiversity practices, our challenge is to assess if practices are effectively maintaining biodiversity over time. The first step in this process began prior to the introduction of FRPA, with an evaluation of wildlife tree retention under the Forest Practices Code (FPC) for cutblocks harvested between 1996 and 2001. Results from that study showed retention was present on 91% of the sampled cutblocks. Where retention occurred, the maintenance of pre-harvest habitat attributes was generally good, with the important exception that large trees and large standing dead trees (>70 cm dbh) were found to be very rare in post-harvest stands.

Under the FRPA Resource Evaluation Program (FREP), a routine stand-level biodiversity monitoring protocol is being pilot tested to help determine the quality of retention on harvested stands and flag potential issues for further detailed (intensive) evaluation. This pilot was designed, in part, based on the lessons learned from the previous FPC evaluation project. The scope of this pilot differs from the FPC wildlife tree evaluation in that other significant components of stand-level biodiversity are included such as coarse woody debris (CWD) and understory vegetation. The intensity level of the monitoring protocol is reduced with fewer measurements; however, more categorical data is collected compared to the original FPC evaluation. This fits with the changing scope of the monitoring protocol–less emphasis on the volume of timber included in the retention and more emphasis on maintaining valuable stand-level attributes (similar to unmanaged stands). Benchmark data collected from neighbouring unharvested stands or from pre-harvest assessments, as well as documented research data, serves as a comparison to determine the success of post-harvest stand-level biodiversity management.

Keywords:

Monitoring, Wildlife Trees, Stand-level Biodiversity, Stand Structure, Forest Practices.

BACKGROUND

Wildlife tree retention has a long history in British Columbia. It was first formally recognized by government in 1985 with the Protection of Wildlife Trees Policy and the formation of the Wildlife Tree Committee. The Wildlife Tree Committee is a multi-agency group (BC Environment, Workers' Compensation Board, and Ministry of Forests), with the objective to "promote the conservation of wildlife trees and associated stand-level biodiversity in a safe and operationally efficient manner in forest, park and urban environments." One of the committee's more specific objectives is "to ensure the maintenance and enhancement of wildlife trees in order to sustain the species dependent on them (approximately 80 species, or 15% of the province's birds, mammals and amphibians. Over the years, the Wildlife Tree Committee has successfully communicated the importance of wildlife tree retention, as well as developed an assessment tool that allows the integration of stand structure retention (wildlife trees) into work environments (harvest areas) in a safe manner)." (Wildlife Tree Committee 2004).

The guidance and training initiated with the formation of the Wildlife Tree Committee, along with growing recognition for the need for biodiversity management, eventually led to wildlife tree retention forming a significant component of the biodiversity management initiative included in the Forest Practices Code of British Columbia Act (1995). This biodiversity management initiative was based on the Coarse Filter/Fine Filter Model. In September 1995, the British Columbia government released the Biodiversity Guidebook (Province of B.C. 1995), which outlines some of the key assumptions associated with biodiversity management. One stated assumption of the coarse filter approach is that the habitat needs of most forest species will be provided for by maintaining a variety of patch sizes, seral stages, and stand structures within each ecosystem. In addition, the coarse filter relies on "adequate representation (distribution and abundance) of ecological land units considering the historical range of variability based upon an understanding of the natural disturbance regimes of the ecological land units. This coarse filter approach does not necessarily prescribe reserves, but rather recognizes ecological processes and provides for a dynamic distribution of ecological units across the landscape over time. Individual species (species at risk, special interest) fine filter assessments are conducted to evaluate whether a sufficient amount and distribution of habitat is provided under the coarse filter strategy. Thus, a coarse filter strategy has been viewed both as a reserve system and as an approach to managing dynamic landscapes considering natural disturbance regimes." (USDA Forest Service 2004). In British Columbia, wildlife tree retention is a main component of the coarse filter approach at the stand level.

The introduction of the Forest Practices Code of British Columbia Act (1995) created a legal requirement for forest licensees to plan for wildlife tree retention. The amount of wildlife tree retention (percentage of the cutblock area) was described in the Biodiversity Guidebook (Province of B.C. 1995). The amount of retention varied depending on the level and distribution of existing and planned harvesting in the surrounding landscape. Government was tasked with dividing the province into a series of landscape units of land and water that formed the planning unit for resource management activity. Landscape units were seen as important for designing strategies for landscape-level biodiversity, and included the designation of a biodiversity emphasis of high, intermediate or low, based on an assessment of the biological value and the predicted risk to those values. Within landscape units, the percentage of wildlife tree retention was set for each ecosystem. In the absence of completed landscape unit plans, Ministry of Forests district managers had the ability to set targets for wildlife tree retention in forest-level and site-level plans.

In 2003, forestry legislation in British Columbia changed with the introduction of the Forest and Range Practices Act (FRPA). This new act increased the emphasis on management results, and included regulations with specific objectives for 11 identified resource values, including stand-level biodiversity. The Forest Planning and Practices Regulation (January 2004) states "the objective set by government for wildlife and biodiversity at the stand level is, without unduly reducing the supply of timber from British Columbia's forests, to retain wildlife trees." [section 9(2)]. More specifically, section 66 of the regulation includes a default retention level to ensure implementation of wildlife tree retention. This only relates to the percentage of the cutblock to be retained, with no specific legal direction on the type of structural attributes retained.

In addition to the legal requirements of FRPA, guidance is provided to forest practitioners in the Wildlife Tree Policy (Ministry of Forests 2001). This policy exists to help guide practitioners to retain the most important stand structural attributes in a safe manner, with consideration of timber supply impacts. With the long history of guidance, policy and legislation, it became clear that there is a need to assess how well wildlife tree retention is being implemented and to try to determine the effectiveness of the retention. The first step in this process began in 2001, with a project titled Evaluation of Wildlife Tree Retention for Cutblocks Harvested Between 1996 -2001 Under the Forest Practices Code. (Bradford et al. 2003).

In this paper, we will attempt to outline the work done to date, including highlights from the FPC wildlife tree retention evaluation project (128 cutblocks), an analysis of baseline data for evaluating wildlife tree patches, and a species needs analysis based on data from the original FPC evaluation. We

will also outline work that is currently underway, some of the lessons we've learned, and potential next steps.

STAND-LEVEL BIODIVERSITY WORK DONE TO DATE

Evaluation of Wildlife Tree Retention for Cutblocks Harvested Between 1996-2001 Under the Forest Practices Code

One of the fundamental questions related to wildlife tree retention (stand structure) that needs to be addressed is: "Are there enough wildlife trees and downed and decaying logs (CWD)?" (Province of B.C. 1996). This question, along with an overarching economic question, "What are the timber supply impacts of wildlife tree retention in British Columbia, and how closely do the impacts resemble original modeling assumptions?", initiated an ongoing project to evaluate the effectiveness of wildlife tree retention in the province. The first phase of this project, titled Evaluation of Wildlife Tree Retention for Cutblocks Harvested Between 1996-2001 Under the Forest Practices Code, had four main objectives:

1. How effectively do current wildlife tree retention (WTR) practices meet the ecological and administrative guiding principles specified in the Provincial Wildlife Tree Policy and Management Recommendations?

2. What are the timber supply impacts of current WTR practices? How much WTR is within the timber harvesting land base (THLB), and how much is within non-contributing or constrained areas (e.g., riparian reserves, operational constraints)?

3. What structural and compositional changes are occurring in WTR areas following harvest? Have these changes affected the ecological value of the retention areas?

   Are there identifiable WTR practices currently being used that achieve ecological objectives and minimize costs?

What Did We Measure?

The project design team considered a number of methods/options to evaluate the project's four objectives. The two most discussed options were: 1) a paper exercise with no field verification (examination of Integrated Silviculture Information System (ISIS) data base, forest cover maps, and silviculture prescriptions); and 2) a field-based sampling of pre- and post-harvest cutblocks from around the province.

Option one would have provided a determination of how much area had been left in wildlife tree retention, but would have given no indication of the quality of the habitat and stand structures retained. Option two, which required both office and field data collection of specific indicators, was selected as it allowed for field verification of mapped information (retention size, shape, amount) and the gathering of information on all retention associated with cutblocks.

During the 2001 field season, a team of experienced professionals randomly sampled 128 cutblocks from 12 forest districts, representing seven of the province's 14 biogeoclimatic (BEC) zones. Cutblocks were the primary sample unit. Within each cutblock, overall estimates were obtained by sampling individual reserves. Cutblocks often had multiple reserves consisting of both patches and dispersed trees. At least one plot was randomly located within each reserve, up to a maximum of 10 plots per patch reserve area. Details of the sampling methodology can be found in the original report (Bradford et al. 2003).

Data collected from each sampled reserve included individual tree data such as tree species, height, diameter, tree class and damage codes, wildlife tree class, wildlife use, withthrow, and hazard tree rating. In addition, overall questions regarding the reserve areas were answered using categorical estimates. Data was collected on the area of reserves, percentage of reserve area that was operationally constrained, percentage of stems affected by insect and disease, and percentage of windthrow. Photos were taken in each reserve, and an overall ecological rating was attained.

What We Found! What is Really Going On!

Of the 128 cutblocks surveyed in the study, 116 (90.6%) contained some form of retention. Of the 116 cutblocks with retention, 20 (15.6%) contained retention with undefined objectives or reserves for purposes other than stand-level biodiversity. Twelve of the 128 sampled cutblocks (9.4%) had no retention. When combined, 25% of the sampled cutblocks either had no retention, contained retention with undefined objectives, or contained reserves for purposes other than stand-level biodiversity.

Approximately 80% of the total retention area was retained in patch reserves, with the remaining 20% contained in dispersed retention. Both patch and dispersed retention retained trees with high wildlife tree values; however, patches generally had more high-value wildlife trees. Dispersed retention contained very few trees from wildlife tree classes 6-9. In other words, it appears that patch retention is better at retaining trees that have a greater degree of decay.

The evaluation showed a trend towards smaller average heights and diameters in reserve trees compared to average pre-harvest heights and diameters. Of the 51 BEC zone/species combinations, 94% showed reductions in average height, 59% showed decreases in average diameter.

The years since harvest varied from one to five in the study cutblocks. Examination of windthrow in reserves did not show significant levels. Approximately 70% of sampled cutblocks had less than 5% windthrow, 96% had less than 20% windthrow.

The estimated timber supply impacts due to wildlife tree retention weighted by the sample strata were 3.5% by volume and 4.3% by area. Broken down by Coast and Interior: Coast–3.3% by volume and 4.5% by area; Interior–3.6% by volume and 4.2% by area (Bradford et al. 2003).

Subsequent to the completion of the wildlife tree evaluation project, Pandion Ecological Research was contracted to examine the extent to which patterns and levels of wildlife tree retention served to provide habitat for the full range of vertebrates that use wildlife trees (Machmer et al. 2004). This work included a literature review to describe the tree-specific habitat requirements of wildlife tree dependant species. Pandion's report compares the data collected from the 128 cutblocks with the literature-based habitat requirements and reported densities of habitat elements in unmanaged stands.

The report titled Preliminary Assessment of the Effectiveness of Wildlife Tree Retention on Cutblocks Harvested Between 1999-2001 Under the Forest Practices Code (Pandion 2004) raises concerns regarding the absence of functional (>20cm dbh and >10m height wildlife tree classes 3-9) wildlife trees. On 46% of all cutblocks sampled, no functional wildlife trees were reported, and only low levels of high-value wildlife trees were reported on the remaining cutblocks. The report goes on to conclude that based on this initial assessment, the life requisites of wildlife tree dependant species will not likely be met in managed forests alone. The report also points out that low densities of large live trees with evidence of decay, insects or cavities may be problematic for some species.

In September 2004, an additional report (Huggard 2004) was completed that compiled existing datasets on tree and standing dead tree densities in unmanaged Coastal Western Hemlock (CWH) Engelmann Spruce Subalpine fir (ESSF) and Interior Cedar Hemlock (ICH) stands. Existing datasets, such as the Vegetation Resources Inventory (VRI), Provincial Ecology Program (PEP), Weyerhaeuser Coastal B.C. Habitat Structural Monitoring, Ministry of Water, Land and Air Protection/University of British Columbia Benchmark Project on Vancouver Island, and a number of other data sets were used. These datasets allow baseline comparisons with a subset of the wildlife tree data collected as part of the 128 cutblock evaluation.

Example comparisons were developed for all stems, all standing dead trees, standing dead trees >10m tall, and standing dead trees and stems by size, wildlife tree class and species. The main use of these comparisons is to identify weak points in retention, with the intent of focusing efforts on improving these weaknesses and helping to focus more extensive monitoring projects.

The comparison of wildlife tree data collected in the 128 cutblock evaluation and the baseline datasets identified several areas for potential improvement and further examination:

- Low overall densities of the largest trees and standing dead trees in the drier CWH subzones, dry ESSF and wetter ICH.

- Low overall densities of standing dead trees, especially conifers, in wetter CWH.
- Low overall densities of standing dead, tall standing dead, and larger standing dead trees in wetter ESSF.

The overall number of indicators that could be compared was limited as not all of the baseline datasets collected the same information as was collected in the 128 cutblock evaluation. The analysis is also limited in time, and only indicates standing dead tree values immediately after harvest. If one of the objectives of wildlife tree retention is the recruitment of wildlife trees, then monitoring these retention areas over time, along with modeling, should provide greater insight into what is happening.

WHAT ARE WE CONTINUING TO DO?

All of the work referred to in the above section is just a beginning to try and understand the implementation and effectiveness of wildlife tree retention as a coarse filter means of maintaining stand-level biodiversity. The new FRPA has changed the focus of government staff from reviewing and approving plans to monitoring results. This shift has created the need for greater emphasis by government and industry in understanding the effectiveness of forest practices implemented in British Columbia. Recognizing the expense and resources required to conduct intensive monitoring over large areas, the Ministry of Forests and the Ministry of Water, Land and Air Protection, along with other partners, have initiated a pilot project of routine-level monitoring for stand-level biodiversity. The intent of this monitoring is to identify trends, raise "red flags", and allow for more focused, cost-effective intensive monitoring where it is needed. As with any monitoring program, there is concern that the indicators must be sufficiently sensitive to actually raise "red flags", and that they provide meaningful feedback for management decisions.

The FRPA Resource Evaluation Program (FREP) Pilot Project of Stand-level Biodiversity Routine Indicators

"Routine Monitoring" has been defined for the purpose of the FREP program as: "low intensity overview evaluations (lower rigour as compared to extensive and intensive evaluations) that use indicators that can be obtained at most sites (relatively simple qualitative measures, such as visual estimates and yes/no answers). Rating levels are described prior to field assessment to ensure consistency in rating of observations and information collected." (FREP 2004).

The stand-level biodiversity pilot project is meant to test a suite of indicators and field methodologies that allow for rapid data collection. The program design calls for routine monitoring to be implemented by the Ministry of Forests and the Ministry of Water, Land and Air Protection district and regional staff, with the goal of sampling a larger number of cutblocks than would be possible if more intensive data collection was utilized. It is hoped that the information collected will provide feedback to practitioners and decision makers, as well as provide data for ecosystem-based analysis on the level of implementation and trends associated with various indicators.

The indicators for the stand-level routine monitoring build on work completed to date both in previous government monitoring and industry/university partnerships. The stand-level biodiversity cutblock and plot indicators now include:

- Cutblock size;
- Reserve size and type (patch or dispersed);
- Landscape context–percent of landscape harvested and percent of landscape in the timber harvesting land base;
- Plot-based data on tree size and wildlife tree class;
- Plot-based data on cover layers, including species and percent cover;
- CWD data;
- Identification of the percent reserve area operationally constrained (i.e., sensitive soils, wetlands, rock outcrops, etc.);
- Presence of ecological anchors (i.e., bear dens, veteran trees);
- Percentage of windthrown trees; and

- Identification of noticeable species shifts, or changes in height or diameter of leave trees. (FREP 2004, Kremsater et. al 2004).

Many of these indicators were used in the original 128 cutblock evaluation (Bradford et al. 2003); however, in an attempt to reduce the amount of time spent at each cutblock (average 1 cutblock per day in the 128 cutblock evaluation), the new routine methodology (see Appendix 1) collects categorical data for diameter, CWD length, estimates of tree height, and windthrow percentage. The shift from measuring tree diameters and heights to using categories (i.e., 12.5-20 cm DBH) does not allow for detailed volume calculations, but will continue to allow for examination of trends in changes in size by species and wildlife tree class. The routine methodology also eliminates the requirement to collect defect information on each tree sampled. Preliminary field testing of the indicators and methodologies has shown that field time can be reduced from an average 5-7 hours to 2-3 hours per cutblock. More complete information on time spent in the cutblocks will be available at the end of the pilot project.

The new routine methodology also puts a greater emphasis on collecting "baseline" data for comparison. Ideally, pre-harvest data would be collected to allow for some level of direct comparison. If this information is unavailable, then field assessors are asked to collect data in an adjacent stand if they believe that stand is representative of the pre-harvest condition. Careful examination of this data to determine its usefulness will have to be carried out, as baseline data collection will add time and expense.

Compilation and analysis of the pilot project data will be completed in early 2005. Part of the pilot project evaluation will include determining whether data collected through the more qualitative routine methodology provides meaningful feedback to forest practitioners, indicates areas of concern for more intensive evaluations, and/or provides information for immediate continuous improvement at the local level (e.g., improved objectives and strategies for Forest Stewardship Plans, improved field practices). We need to clearly understand the limitations of this methodology and effectively communicate this to practitioners.

WHAT HAVE WE LEARNED?

In terms of wildlife tree retention implementation, we have learned that stand structure is being retained within most of the cutblocks in British Columbia (91% of cutblocks sampled had some form of retention). Concern has also been raised that the number of large dead trees retained may become limiting for biodiversity. Work needs to be done to examine how extensive this issue might be, and how forest stand structures fit into the landscape both in the short and longer term. Additional study needs to be done to try and understand how species react to the variety of patterns of retention and various densities of live and dead retention.

We have also learned that our previous wildlife tree retention guidelines were not as clear as they should have been. The results of the 128 cutblock evaluation will help us develop improved guidelines and wildlife tree retention policy.

As with all projects, documenting lessons learned is often difficult. Appendix XII of the 128 cutblock evaluation (Bradford et al. 2003) details eight lessons learned. We have tried to incorporate those lessons into the routine stand-level biodiversity monitoring methodology. Some of the key points include:

- Before you begin, understand your goals and objectives. Be clear on what it will take to achieve them.
- Operationally test proposed methodologies. This includes pilot testing data evaluation and analysis. Without pilot tests, data may be collected that is never used, or even worse, necessary data may be overlooked.

Prepare and train thoroughly. A good quality assurance plan begins with training. Ensure field staff understand the evaluation goals and objectives and have a comprehensive knowledge of the methodologies. Maintain the ability to communicate issues to the entire project team throughout the field season.

Answering the question, "Are practices effective at maintaining biological values?" is difficult in the absence of scientific information on levels of biological significance; however, examining trends in

key indicators and looking for weaknesses in stand structure retention can provide useful feedback to practitioners and decision makers. It is important to begin working towards answering some of the key monitoring questions, because without this work, it will be difficult to maintain British Columbia's world-class forest industry.

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REFERENCES

Bradford, P., W. Bergerud, N. Densmore, E. Hamilton, A. Prasad, and R. Thompson. 2003. Evaluation of Wildlife Tree Retention for Cutblocks Harvested Between 1996-2001 Under the Forest Practices Code. B.C. Min. For. and B.C. Min. Water, Land and Air Prot., Victoria, B.C. (http://www.for.gov.bc.ca/hfp/wlt/WLTEvaluation-Final-web.pdf). Accessed October 2004.

British Columbia Ministry of Forests. 2001. Wildlife Tree Policy. Province of British Columbia, Victoria, B.C. (http://www.for.gov.bc.ca/hfp/wlt/wlt-policy-01.htm). Accessed October 2004.

British Columbia Ministry of Forests. 2004. Wildlife Danger Tree Assessment Procedure. Province of British Columbia, Victoria, B.C. (http://www.for.gov.bc.ca/hfp/wlt/wdtac.htm). Accessed October 2004.

FRPA Resource Evaluation Program. 2004. (http://www.for.gov.bc.ca/eefinder/3-12-indicators.asp). Accessed October 2004.

Huggard, D. 2004. Baseline Datasets for Evaluating Wildlife Tree Patches. B.C. Min. For. and B.C. Min. Water, Land and Air Prot., Victoria, B.C. Unpublished report.

Kremsater, L., R. Holt, and D. Huggard. 2004. Effectiveness Monitoring for FRPA Stand and Landscape Biodiversity Values. B.C. Min. For., Victoria, B.C. Unpublished paper.

Machmer, M. and C. Steeger. 2004. Preliminary Assessment of the Effectiveness of Wildlife Tree Retention on Cutblocks Harvested Between 1999-2001 Under the Forest Practices Code. B.C. Min. For., Victoria, B.C. Unpublished paper. (http://www.for.gov.bc.ca/ftp/hfp/external/!publish/wtc/WTA%20Final%20Report-M31.pdf). Accessed October 2004.

Province of British Columbia. 1995. Forest Practices Code of British Columbia Biodiversity Guidebook. B.C. Min. For., Victoria, B.C. http://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/biodiv/biotoc.htm, Accessed October 2004.

Province of British Columbia. 1996. Initiatives for the Conservation of Biodiversity in British Columbia, B.C. Min. For., Victoria, B.C.

USDA Forest Service. 2004. Coarse Filter/Fine Filter Planning Approaches to the Conservation of Biological Diversity. (http://www.fs.fed.us/emc/nfma/includes/coursefilter.pdf). Accessed October 2004.

Wildlife Tree Committee. 2004. (http://www.for.gov.bc.ca/hfp/wlt/index.htm). Accessed October 2004.

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