Predicting the Visual Impacts of Retention Cutting

BRITISH COLUMBIA forests have many uses, and sometimes these uses conflict. The visual quality of forested landscapes is becoming an increasingly contentious issue as competition intensifies for limited forest resources in the province.

The choice of silvicultural system is an important consideration when addressing visual quality. Although clearcutting is widely used in British Columbia, it often makes it difficult to meet more restrictive Visual Quality Objectives[1] (VQOs). As a result, there has been a move towards using the retention silvicultural system as a means of maintaining visual quality when harvesting timber. However, knowing how to achieve an acceptable visual result has become an issue.

The objective of this study was to determine how to predict the visual impacts of retention harvesting.

The purpose of this publication is to describe the methodology used in this study and to inform the public and field practitioners of the results.

[1]A VQO is a resource management objective established by the district manager or contained in a higher-level plan that reflects the desired level of visual quality based on the physical characteristics of and social concern for the area. (Operational Planning Regulation, sec.1).

An Introduction to
Calculating the Visual Impact of Retention Cutting

WHAT IS A SILVICULTURAL SYSTEM?

A silvicultural system is a planned program of activities for harvesting, regenerating, and tending a forest stand or group of trees over an extended period in order to achieve a predictable yield of benefits. There are seven general silvicultural systems in use in British Columbia:

- clearcutting
- patch cut
- seed tree
- coppice
- selection
- retention
- shelterwood

WHAT IS THE RETENTION SYSTEM?

The retention silvicultural system involves maintaining structural diversity over the area of a cutblock by retaining individual trees or groups of trees for at least one rotation. Retained trees can be dispersed throughout the block as single trees or as an aggregated group of trees, or a combination of both. SEE FIGURE 1

FIGURE 1

In a Retention System at least 50% of the harvest unit is within one tree height (under the influence) of a standing tree. (Ref. Silvicultural Systems Handbook for British Columbia 2001). SEE FIGURE 2

STUDY OBJECTIVE

The objective of this study was to determine if there is any individual variable or any combination of site and stand variables that can predict visual quality when using a Retention System.

METHODOLOGY

Sampling Criteria

The study identified 51 blocks in coastal and interior regions of the province as sample sites. The criteria for selecting sites were as follows:

- harvested blocks with a component of retained overstory trees in a variable or patchy distribution
- stands on slopes of 30% or greater
- stands that could be photographed from mid-range (1–5 km)
- stands with complete pre-harvest data
- stands that were ground-accessible

Data Collection

Data were gathered from pre-harvest silvicultural prescriptions and from on-the-ground site visits. At each of the study sites, a post-harvest cruise was conducted. This involved locating and traversing a 750-metre strip line through a typical portion of the harvested block and sampling every 25 metres. SEE FIGURE 3

FIGURE 2

For each of the 51 study sites, 70 individual attributes were collected. From this list, 22 potential predictors of visual quality were chosen for statistical analysis:

- Scale of alteration (%)
- *Old or second growth*
- Avg. size of opening (ha)
- Avg. distance to nearest patch (m)
- No. of plots with no merchantable basal area
- *No. of plots falling in patches*
- Post-harvest basal area (m^2/ha)
- Post-harvest density (stems/ha)
- Basal area removed (%)
- Stems removed (%)
- No. of plots with no tree influence
- Area under influence of trees (%)
- *Crown width (m)*
- *Slope (%)*
- *Avg. no. of trees influencing plot*
- Post-harvest avg. diameter at breast height (cm)
- *Visual absorption capacity*
- Visual design (good, moderate or poor)
- Volume removed (%)
- *Post-harvest avg. tree height (m)*
- Post-harvest volume (m^3/ha)
- *Live crown ratio (%)*

See *Statiscical Analysis* for explanation of italics.

Each study site was also photographed from a 1–5 km distance as well as from within the block. The photos of the sites were classified into four visual quality classes (VQCs) by a team of MoF visual resource management specialists. The four classes are Retention (R), Partial Retention (PR), Modification (M), and Maximum Modification (MM).

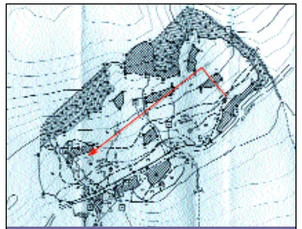
Statistical Analysis

A variety of statistical analysis techniques were used to try to correlate visual quality with cutblock site and stand variables.

Blocks were first grouped by VQC (R, PR, M, and MM). The 22 predictor candidates were then compared among the four VQCs to determine if there was evidence of correlation. Of the 22 potential predictors, eight (shown in italics in previous section) were found to have no significant correlation and were therefore dropped in subsequent analyses.

Univariate logistic regression models were fitted for each of the 14 short-listed predictor variables in order to identify the single "best" predictor of visual quality (i.e., the predictor that was most strongly correlated with VQC). Two visual quality classes were excluded from logistic regression analyses due to inadequate sample sizes – Retention (n=2) and Maximum Modification (n=3).

A multivariate logistic regression model was applied to the 14 predictor variables in order to identify the best combination of variables that would predict visual quality. The data from all 51 samples were used in the multivariate analysis, but R was combined with PR, and MM with M.



BLOCK VR I02 PLAN VIEW The red line shows the location of the cruise transect through the block

BLOCK VR I02 PHOTO VIEW The red line shows the location of the cruise transect through the block

FIGURE 3
Block VR 102 illustrates how sampling was done.

Using the
Research Results

Logistic regression analysis of data suggests that 14 of the 22 variables initially considered had at least some value for predicting visual quality. "Percent alteration appears to be the single best predictor (P<.0001)." Percent volume removed or percent basal area remaining was the second best predictor (P<.0014 and P<.0015, respectively). Visual design was the third best individual predictor of visual quality (P<.0039).

Multivariate logistic regression analysis suggested that percent alteration (percent area), design (good or poor), and volume removed (percent) were the "best" combined predictors of VQC. Adding design and volume removed (or variables closely correlated with volume removed, such as basal area removed) to percent alteration resulted in a significant improvement in the predictive power of the fitted model compared to percent alteration alone. Good visual design and a reduction in the volume removed appear to increase substantially the percent alteration threshold at which a block with retention is more likely to be classified as Retention/Partial Retention than Modification/Maximum Modification. Figure 4 clearly shows the benefits of using visual design.

Table 1 and Figure 4 overleaf both depict the probability that a randomly selected block will be classified as M/MM (and not R/PR).

Using the Research Results *continued*

As a result of this research, it is now possible for practitioners to predict the visual quality of proposed retention openings that occur on middle-ground landscapes with 30–75 percent slopes and 75 percent or greater volume removal.

TABLE 1
Visual quality prediction of retention openings

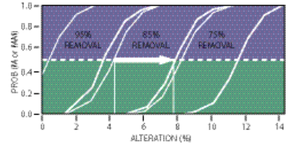
Partial Retention (PR)
Modification (M)

ALTERATION	VOLUME REMOVED 75% GOOD DESIGN	75% MOD/POOR DESIGN	85% GOOD DESIGN	85% MOD/POOR DESIGN	95% GOOD DESIGN	95% MOD/POOR DESIGN
0%	0.00	0.00	0.00	0.00	0.00	0.37
1%	0.00	0.00	0.00	0.01	0.02	0.71
2%	0.00	0.00	0.00	0.04	0.08	0.91
3%	0.00	0.00	0.00	0.14	0.26	0.98
4%	0.00	0.00	0.01	0.40	0.60	0.99
5%	0.00	0.01	0.02	0.74	0.86	1.00
6%	0.00	0.04	0.09	0.92	0.96	1.00
7%	0.00	0.16	0.29	0.98	0.99	1.00
8%	0.01	0.44	0.63	1.00	1.00	1.00
9%	0.03	0.77	0.00	1.00	1.00	1.00
10%	0.10	0.93	0.00	1.00	1.00	1.00
11%	0.33	0.98	0.00	1.00	1.00	1.00
12%	0.67	1.00	0.00	1.00	1.00	1.00
13%	0.89	1.00	0.00	1.00	1.00	1.00
14%	0.97	1.00	0.00	1.00	1.00	1.00
15%	0.99	1.00	0.00	1.00	1.00	1.00
THRESHOLD	11.5%	8.2%	7.6%	4.3%	3.7%	0.4%

Determine (from your visual simulation) what the percent alteration of your proposed block will be on the landform. Next determine what level of removal is planned within the block: 75, 85, or 95%. Identify if visual design principles (e.g., lines of force analysis) were used to guide block design. With the above information, follow the percent alteration (Y) axis across and the volume removed (design) (X) axis down. Their intersection point will yield the VQO you will most likely achieve.

FIGURE 4
Percent alteration as a function of retention

Modification (M)
Partial Retention (PR)



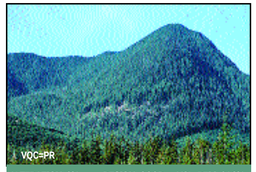
The thin line represents poor and medium design; heavy lines represent good design. Volume removed is recorded left to right at 95, 85, and 75%. The dotted horizontal line denotes a 50/50 probability that a given alteration would be classified either as M/MM or R/PR. The white arrow shows the benefit of practising good visual design.

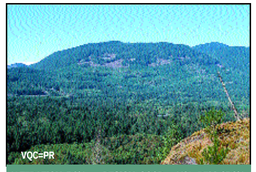
FUTURE RESEARCH

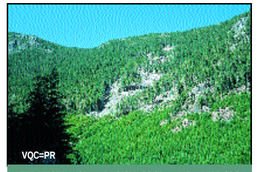
It is important to collect more samples in order to further refine the predictive capability of retention for achieving each VQO.

A public perception study is needed to investigate the public response to various levels of harvesting using the Retention System.

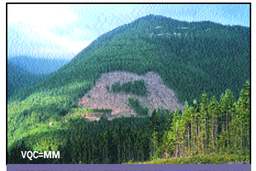
OPENINGS WITH GOOD DESIGN

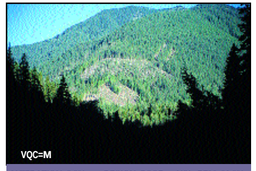


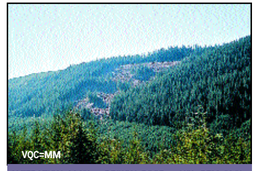




OPENINGS WITH POOR DESIGN







PARTIAL RETENTION EXAMPLES

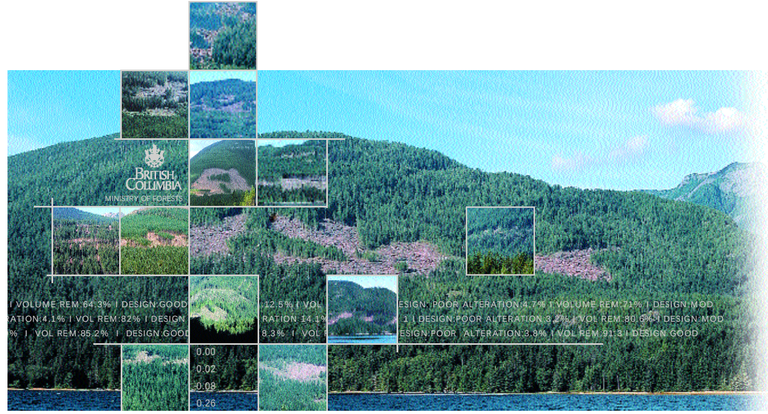
MODIFICATION EXAMPLES

BRITISH COLUMBIA
Ministry of Forests
Forest Practices Branch

For more information on visual quality and retention harvesting, contact your nearest Forest Service office or Forest Practices Branch, B.C. Ministry of Forests, PO Box 9513 Stn. Prov. Govt., Victoria BC V8W 9C2, Tel: (250) 387-8481, Fax: (250) 387-5909.

QP4500084288 11/02

Predicting the Visual Impacts of **Retention Cutting**



FOREST PRACTICES BRANCH