Deliverable # 7

Public Perception of Variable Retention Harvesting

A research report investigating public perceptions of various levels and patterns of green-tree retention

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TABLE OF CONTENTS

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1.0 INTRODUCTION

This article summarizes work undertaken as part of a research project aimed at investigating public acceptability thresholds in conjunction with the use of variable retention (VR) harvesting (also known as green-tree retention). Studies such as this are intended to help develop practical, scientifically based guidelines for managers on thresholds of visual acceptability using a variety of operationally feasible variable retention harvesting methods. It is important to establish the relative levels of effectiveness of different harvesting practices/designs used, in relation to the levels of retention of trees that are left in the harvesting blocks. At the end of the day, the question comes down to: is variable retention achieving the public perception gains it was meant to achieve, and if the answers are mixed, what is working and what is not?

More specifically, three issues or research questions were investigated:

- The public acceptability of various harvesting practices
- The degree of visible stewardship demonstrated in the harvesting designs (amount of perceived care)
- The degree to which people can distinguish between the practice of variable retention and the practice of clearcutting.

The objective of the study presented here is to assess the performance of recent variable retention practice on these three perceptual questions, and to attempt to pin-point thresholds (e.g. acceptability thresholds) for various retention levels and harvesting patterns.

1.1 Background information and study rationale

For decades, visual quality has been a major issue in forest management in BC and many other places around the world (Sheppard, 2001). It represents an important public resource value, yet has also been seen by industry as a constraint on timber supply (Picard and Sheppard, 2001). In 1998, Weyerhaeuser (then MacMillan Bloedel) announced that it would be phasing out clearcutting and launched the concept of variable retention (as defined in Franklin et al. [1997] and in Mitchell and Beese [2002]), partly as a way of satisfying public acceptability concerns. (MacMillan Bloedel Ltd., 1998).

Public perception testing in response to timber harvesting has been undertaken repeatedly over the last three decades (eg. Ribe, 1999; Palmer et al., 1995; BC MOF 1996). Knowledge of public responses to clearcutting have been present in most studies, and are relatively well understood. For example, it has been shown that in clearcutting, the scale of the block, as expressed in the BCMoF percent alteration (% alt.) measure (BCMOF, 1996, 2003) is one of the better predictors of visual quality. However, to date, very little research has been undertaken on public perceptions of various tree retention levels and retention patterns that forest managers can apply to a site when using the practice of variable retention. More specifically, public perceptions of variable retention, when dispersed retention is left onsite, have seldom been investigated. Examples of questions that need be answered include:

- At which dispersed retention removal level does a cut block start to be visually unacceptable?
- At which dispersed retention removal level does a cut block start to be perceived as a clearcut (in which case the percent alteration measure could be applied)?
- Are there major differences in public preference for different variable retention harvesting patterns?

The research project described here builds upon past BCMoF research, which provides several key concepts and premises. First, past BCMoF perception studies (BCMoF, 1996; 1997) have shown that the public perceives clearcuts very differently from partial cuts (dispersed retention cuts). This indicates that when attempting to meet a given Visual Quality Objective (VQO), the acceptable amount of removal that can be harvested, both under a clearcut approach (or VR with aggregated retention) and under partial cutting (VR with dispersed retention or "Dispersed Retention cutting"), varies, among other things, with the harvesting technique used in a given VQO class, (Picard, 2002). In other words, for a given harvested timber volume, people prefer the use of dispersed retention cutting (from a visual perspective) over the use of clearcutting. However, as the percent removal within the dispersed retention cut increases, there will come a point where the logging operation will cease to look like a dispersed retention cut and will take on some of the visually adverse characteristics usually associated with a clearcut, potentially provoking a sharp drop in visual quality (as suggested by the BCMoF data published to date). It is this threshold that managers need to understand in order to make decisions regarding public acceptability of timber harvesting under variable retention and compliance with VQOs.

The issue of visible stewardship has been raised by Sheppard (2001), both as a partial theoretical explanation for public perceptual judgments of forest management activities, and as a guideline for forest management practice. The public may not be responding only to notions of scenic beauty or visual contrast with natural landscapes, but also (or perhaps more) to the degree to which the forest looks well managed. For example, in a working forest setting, perhaps good design and demonstrated evidence of care for the local landscape may improve public opinions, even though the site is clearly not perceived as being in a "natural condition". This study is one of the first to test this notion and explore the linkages between visible stewardship and acceptability of harvesting practices. Since the term visible stewardship is relatively new and not widely understood, the concept of 'care for place' was used when addressing this issue.

2.0 METHODS

The research design used in this experiment was broken up into 3 key steps. First, the selection of key research questions that would contribute to the understanding of the issues mentioned above. Second, the selection of key timber harvesting images/photographs to be shown to respondents in order to get perceptual responses of those images for the research questions of interest. Third, the presentation of those images to human subjects and the collection of perceptual ratings for each question based on the images presented.

2.1 Research questions asked to the respondents

Four questions were identified as being highly relevant to the research project described in this paper, focusing on the three issues identified above (the distinction from clearcutting acceptability, and visible stewardship). Perceptual ratings were collected for the three main questions (questions A, B, and C), and one open-ended question on visible stewardship (question D). These questions were as follows:

Question A
Do you think the timber harvesting approach shown in the image is clearcutting? Please place a mark under the appropriate heading (Yes, No, Not sure).

Question B
If logging were to look like what is shown on the image, would it be acceptable to you? (Please circle the appropriate value under the appropriate heading for each image shown, 1 being very unacceptable and 5 being very acceptable).

Question C
Based on the appearance in the photograph, how much do you think the forest managers care about the places shown? Please circle the appropriate value for each scene shown, from 1 (Managers don't care at all) to 5 (Managers care very much).

Question D (open-ended question)
Based on the photographs you have seen or your own personal experience, please indicate (in a few words) any features in the landscape which would: a) suggest to you that forest managers care about the places they are managing; b) suggest to you that forest managers do not care about the places they are managing.

2.2 Image selection

In order to set up an experiment capable of indicating thresholds between retention levels at a fairly fine level of resolution, a matrix of desired variable retention harvesting sites with an array of retention level and harvesting patterns was created (see Table 1),. The range of retention levels was chosen based on results from previous research, which broadly suggests where those thresholds may lie. From this matrix, Weyerhaeuser staff indicated a list of potential sites suitable for field photography, with the aim of identifying one or more sites per cell in the matrix. Sites were selected primarily from Vancouver Island where the company has the largest number of sites where variable retention has been practised in recent

years. From these sites, flight paths were created and helicopter field photography was undertaken on three separate days, resulting in several hundred pictures taken with both 35mm and 50mm lens (to allow for the possibility of future perceptual comparisons). Of this first set of sites and associated images, and after several selection rounds among the research team, 22 cutblocks (from 21 sites[1]) with one image per cutblock were selected for inclusion in the experiment. From these 22 cutblock images, 14 were also photographed in a broader landscape context (e.g. with a 35mm lens), bringing the final number of images used in the experiment to 36 (22 and 14). This imagery allowed for 19 cells (out of 24) to be filled in the variable retention matrix sought (see Table 1). However, good harvest data could be obtained in time for this report for only 4 of the mixed retention sites, so this pattern of retention was not included in the analysis described in section 3 below.

		Retention levels (in %)							
		6	9	12	15	18	21	24	27
Retention Types	Dispersed Retention	**X**	**X**	**X**		**X**	**X**	**X**	**X**
	Grouped Retention	**X**	**X**	**X**	**X**		**X**	**X**	
	Mixed Retention		**X**		**X**	**X**	**X**	**X**	**X**

Table 1: Matrix of variable retention sites sought for the field photography, showing the cells for with photography was obtained (marked with and "X").

Images sought were of sites for which harvest data was available, taken at the middleground viewing distance (1 km distance was the target distance) as low aerial shots (low elevation aerials, or roughly equivalent to 45 degree viewing angle, so as to provide the best viewing opportunity for the harvesting to be evaluated. Images where other harvesting units are visible in the vicinity, and/or where the harvesting block being evaluated was not clearly evident among other visible harvest units, were not selected. A few images were also edited digitally (using Photoshop) in order to remove as much variation as possible between the images (e.g. water bodies removed, human artifacts removed, other adjacent harvest units removed, etc.).

The classification of the images into harvesting patterns (retention types) was based on both an expert assessment of their "visual" appearance and on their planimetric classification (rather than only on the later) since the visual appearance of a harvesting operation is highly dependant on the viewing angle, observer position, slope conditions, etc.

2.3 Human subjects and experimental setting

2.3.1 Subject recruiting

Given the scientific literature showing that students' ratings of landscape scenes are generally representative of those of the general population, the decision was made to recruit students from the UBC student community, since they are fairly readily available and inexpensive to recruit. The experiment was advertised throughout the University of BC campus, via available student e-mail lists in order to secure a broad audience relative to the time/cost available. Subjects were offerred an honourarium payment of $10 cash. A total of 34 subjects were used in the study.

[1] One site had two images from two different view angles included in the experiment. This site is a silvicultural system trial site, which allowed for both a dispersed retention image and a mixed retention image to be taken from the same site.

Two categories of students were not allowed to participate in the experiment: landscape architecture students and forestry students. Landscape architecture students were not allowed to participate in the experiment because they have received (or are in the process of receiving) "specialized" training and education in landscapes, which includes training in how to "read" and "interpret" the landscape, which could affect their view of the landscape. Forestry students were excluded because they have received (or are receiving) a "specialized" training in harvest practices and in landscape interpretations..

2.3.2 Physical experimental setup

The physical experimental setup used for the experiment was fairly standard. Subjects were brought into CALP's Landscape Immersion Lab (LIL) in UBC's Forest Sciences Center and assigned a numbered seat in front of a 3-screen display. Only 5 seats were used at a time, placed in a row parallel to the screen, located approximately 9 feet 4 inches from the screen, taped to the ground, and centered in front of the screen. This set-up was an extension of a 3-chair setup used in a previous experiment and shown in Figure 1 (without subjects). Only the centre screen was used in this experiment. The measurements for the chairs and the seat positioning were based on Sheppard (1989) which provides clear guidelines on such experimental setups based on screen size and the need to have the image projected in such a way as to match as closely as possible the actual angle of view that would be obtained from the corresponding viewpoint at the site. Taking into account the angle of view obtained in a 50mm camera lens, this would approximate a 40-degree view cone extending from the observer's eyes to the edges of the screen being used (see Sheppard [1989] for more details).

Figure 1: 3-chair experimental setup showing the essence of the experimental set-up used (5 chairs were used on a single row instead of 3 as shown here, with the extra chairs added at each end of the row).

2.3.3 Presentation format

The scientific literature indicates that respondents' fatigue starts to be noticeable in the quality of the ratings after about 60 ratings, and the data starts to be much less reliable beyond 100 ratings, and that three questions (where ratings are sought) are included in the experiment, a total of 92 ratings (including 20 preview images) were sought from each respondent.

The images were presented to the respondents in the form of a controlled slide show, with each image on a timer, accompanied by a brief explanatory narrative delivered by the research facilitator using a script. The images were ordered into two alternative random sequences (in which the question order was also changed), to remove any order effect on responses, and each respondent was randomly assigned to one of the two sequences (also termed experimental conditions). Each image was separated by a blank slide indicating the number of the next image (matching with the response forms) so the respondents could keep track of which question was to be rated. These blank slides were shown for 2 seconds, while the images to be rated (and the preview images) were shown for 10 seconds each.

Preview images (images that were representative of the experimental dataset) were shown before each question. These allowed for the respondents to get familiar with the pace of the presentation, and to show them the full range of imagery contained in the dataset. The respondents were asked to rate the preview images in order to let them become familiar with the rating process for each question asked, but these ratings were not used in any analysis.

An example of a final layout for the presentation of the images is as follow:

- 5 preview images for which the respondents had to provide ratings in order to get them familiar with the rating process specific to the first question being asked.
- 22 images consisting of the experimental images dataset for the first question and for which ratings were collected.
- 10 preview images for which the respondents had to provide ratings in order to get them familiar with the rating process specific to the second question asked.
- 36 images consisting of the experimental images dataset for the second question and for which ratings were collected.
- 5 preview images for which the respondents had to provide ratings in order to get them familiar with the rating process specific to the third question asked.
- 14 images consisting of the experimental images dataset for the third question and for which ratings were collected.

With both sequences (and corresponding subject groups), all 36 images to be rated were seen twice by all respondents, in order to attain a sufficient number of images to allow all three questions to be asked. It was felt that a single repetition of each slide, in random order during the overall presentation, would not permit directed or biased responses to questions when a given image appeared for the second time.

3.0 RESULTS

3.1 Results pertaining to the experimental design used

The following results stem from the initial analysis and should be considered preliminary. Further analysis is planned as part of ongoing research and publishing.

3.1.1 Experimental conditions variables

One of the first things to test, given the experimental design used (varying the question order and the image order) was whether the order in which a question was asked, or the order in which an image was presented had any impact on the ratings obtained. If any of these experimental condition variables had had an impact the data would have had to be analyzed separately, based on that variable. Otherwise, the data could be collapsed and the results would then benefit from a bigger sample pool.

For this purpose, the ratings obtained for each experimental condition (ie. two image/question sequences) were compared for each question, and Pearson correlations were calculated to see if there were major differences in the ratings due to different experimental conditions. An example (for the clearcutting question) is shown in Figure 2, showing that the ratings obtained from both experimental conditions are very similar overall, and can be lumped together for analysis purposes at this stage.

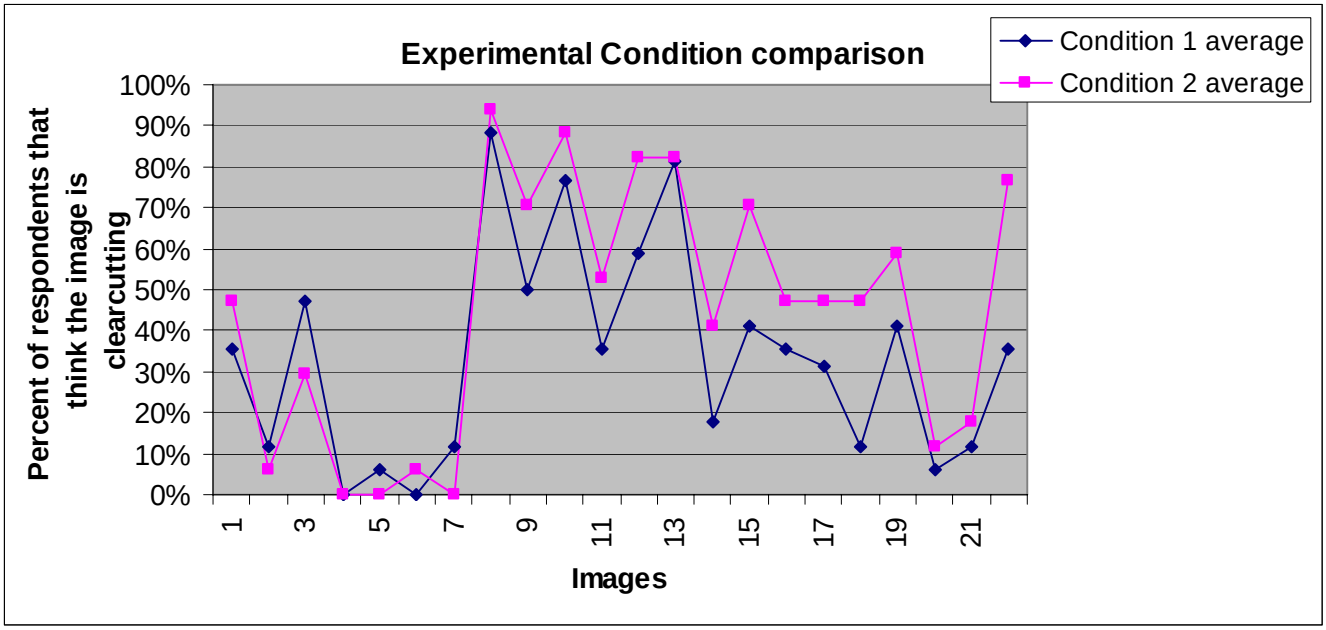

Figure 2: Correlation between the clearcutting question ratings from experimental condition 1 and 2 showing very similar results (Pearson correlation of 0.885).

As a more in-depth analysis, analysis of variances with one factor (experimental condition 1 or 2) was undertaken for each question. Table 2 shows results for the analysis of variance between experimental conditions for the clearcutting question. The results in this and the other cases (for other questions) show that no significant effect resulted from the experimental conditions, as indicated by the fact that the calculated F value is smaller than the critical F value.

ANOVA SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Exp. Cond. 1	22	7.3308824	0.3332219	0.067933
Exp. Cond. 2	22	9.7683824	0.4440174	0.099298

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0.14	1	0.135032	1.614914	0.210796	4.07266
Within Groups	3.51	42	0.0836156			
Total	3.65	43				

Table 2: Analysis of variance output for the clearcutting question with the experimental condition as the factor tested for effect and using the average ratings (17 subjects per condition) obtained for each of the 22 images shown.

3.2 Clearcutting perception results

The purpose of the clearcutting perception question was to establish when and how people distinguish between clearcutting and variable retention. Visual inspection of the regression data shown in Figure 3 suggests that as retention level increases, an increasing proportion of respondents perceive the variable retention harvest unit as different from clearcutting. It also appears that when dispersed retention harvesting is used, the majority of respondents found variable retention harvesting different from clearcutting, even at very low retention levels; conversely, much higher retention levels (in the 20-25% range) would appear to be needed with a group retention approach to achieve a majority of respondents thinking that it is not clearcutting. However, the results may not be as clear as suggested in the graph, as preliminary statistical analysis of results for this question found no significant differences between the two retention patterns. It would therefore be premature at this stage to attempt to pin-point the retention level at which people perceive a variable retention harvest unit as a clearcut, with either grouped retention or dispersed retention.

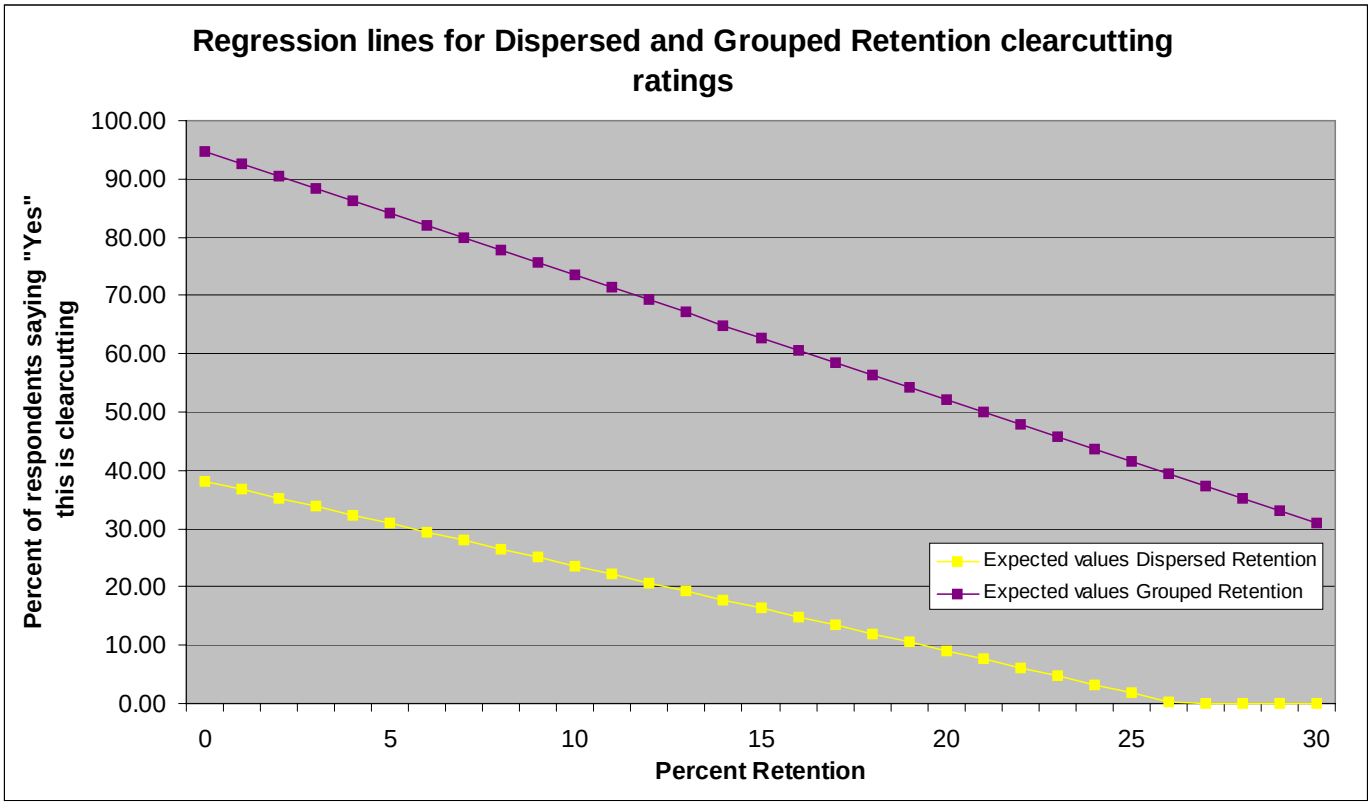

Figure 3: Regression lines (not significantly different from each other) showing the proportion (in percent) of respondents expected to perceive a given image as clearcutting, based on the experimental data collected.

3.3 Acceptability results and effect of retention type and amount on acceptability ratings

One of the purposes of the experiment was to pin-point visual acceptability thresholds and to try to relate those to both the harvesting pattern (type of retention) and the level of retention. In this regard, results obtained show that both retention type and level significantly influence acceptability ratings, and that dispersed retention acceptability thresholds are at much lower retention levels than with group retention. Table 3 below shows these results in more detail, indicating a significant effect for both retention type and the retention level since the calculated F values are greater than the critical F value. Results also show that these factor significantly interact with one another, suggesting that there may be an additional 'aesthetic bonus' when combining higher levels of retention with dispersed retention practices.

ANOVA- Two-Factor With Replication:

	Percent retention					
SUMMARY	6	9	12	21	24	Total
Dispersed						
Count (replications)	34	34	34	34	34	170
Sum	72	137	82	148	168	607
Average	2.118	4.029	2.412	4.353	4.941	3.571
Variance	0.531	0.575	0.856	0.357	0.057	1.702
Grouped						
Count (replications)	34	34	34	34	34	170
Sum	58	80	57	111	71	377
Average	1.706	2.353	1.676	3.265	2.088	2.218
Variance	0.578	0.841	0.710	0.564	0.447	0.952
Total						
Count (replications)	68	68	68	68	68	
Sum	130	217	139	259	239	
Average	1.912	3.191	2.044	3.809	3.515	
Variance	0.589	1.411	0.908	0.754	2.313	

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Retention Type	155.58824	1	155.58824	282.11054	0.00000	3.86979
Retention Amount	203.83529	4	50.95882	92.39787	0.00000	2.39901
Interaction	62.76471	4	15.69118	28.45103	0.00000	2.39901
Within (subjects and/or error)	182.00000	330	0.55152			
Total	604.18824	339				

Table 3: Two-way analysis of variance output testing for differences on the acceptability ratings, with the retention type and the retention amount as the two factors considered.

Following these results, regression analysis was undertaken on the acceptability ratings in order to develop a regression line with confidence intervals for both retention patterns, and to attempt to pin-point acceptability thresholds for both retention patterns. Figure 4 presents those regression analysis results, which show that below retention levels of 3% acceptability ratings for both retention types are not significantly different. Also, Figure 4 shows that beyond this 3% retention threshold, dispersed retention harvesting is significantly more acceptable than grouped retention for any given retention level (up to the levels tested, which are 24% for group retention and 27% for dispersed retention). As an extension of these regression results, there is the potential to compute the retention levels at which a given scene would be expected to become visually acceptable (or expected to get an acceptability rating of 3 on the scale used) for each retention type (assuming a linear relationship a shown in the regression lines in Figure 4). These computations show that with dispersed retention harvesting, 9% retention would be enough to achieve visual acceptability (5% and 14% dispersed retention are the 95% confidence interval lower and

upper limits respectively). With group retention, results show that as much as 31% retention would be needed to achieve visual acceptability (17% and 68% grouped retention are the 95% confidence interval lower and upper limits respectively)[2].

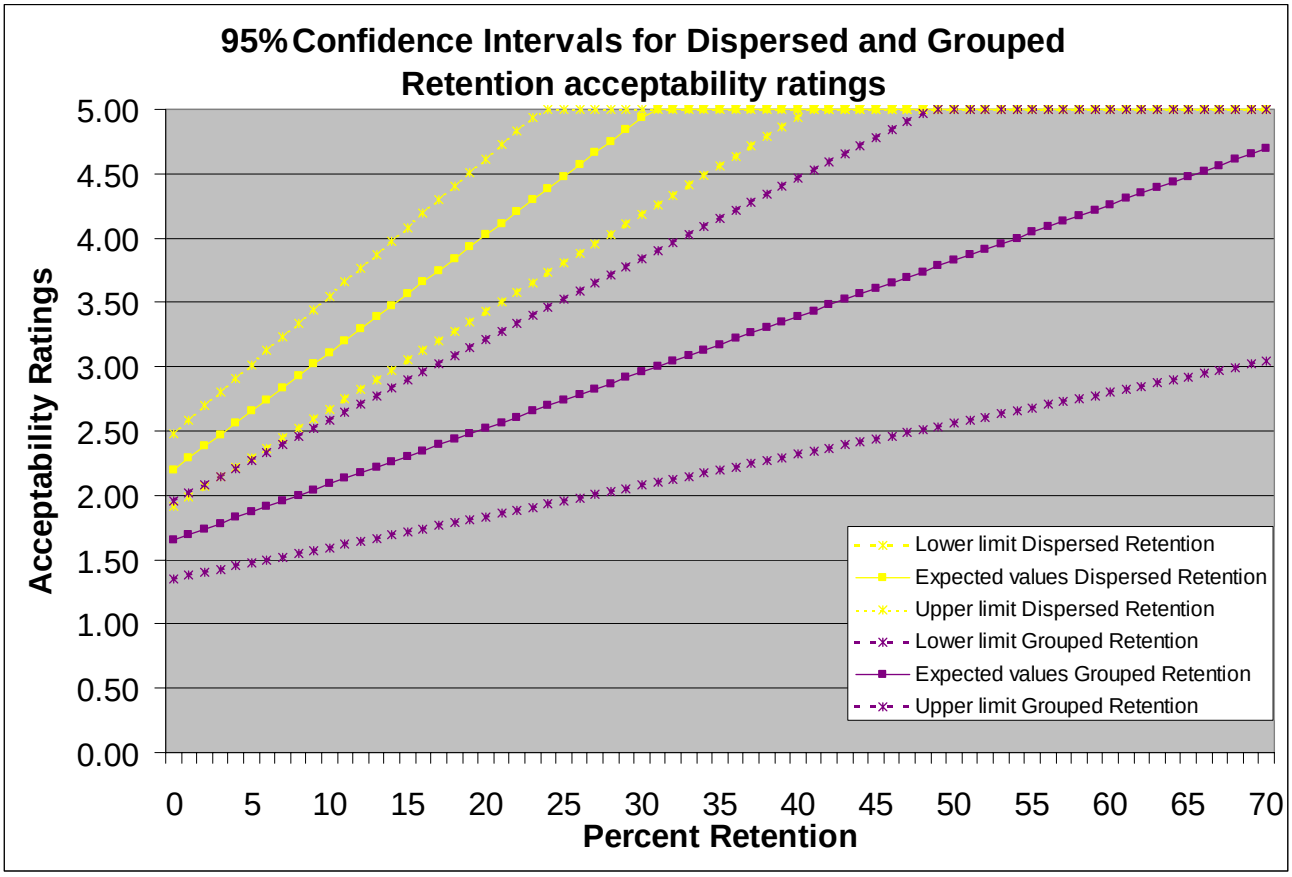

Figure 4: Regression lines for the acceptability ratings for both dispersed retention and grouped retention showing upper and lower 95% confidence intervals.

3.4 Visible stewardship results

The purpose of the question on visible stewardship was to assess whether people's perceptions of care for the land are linked to harvest patterns and/or retention levels. Results show that as retention levels increase, perceived care for the land also increases, though these increases are less pronounced when group retention is used: a positive correlation is observed between perceived care and the retention level left in the harvesting block, as suggested in Figure 5. However, as was the case for the clearcutting question, the statistical results with harvesting pattern for the question were not as clear as hoped, since no significant differences in responses were obtained between the two retention patterns.

[2] It should be kept in mind that the data on which these regression lines are based does not include retention levels above 27% and any extrapolation beyond this retention level should only be considered informational.

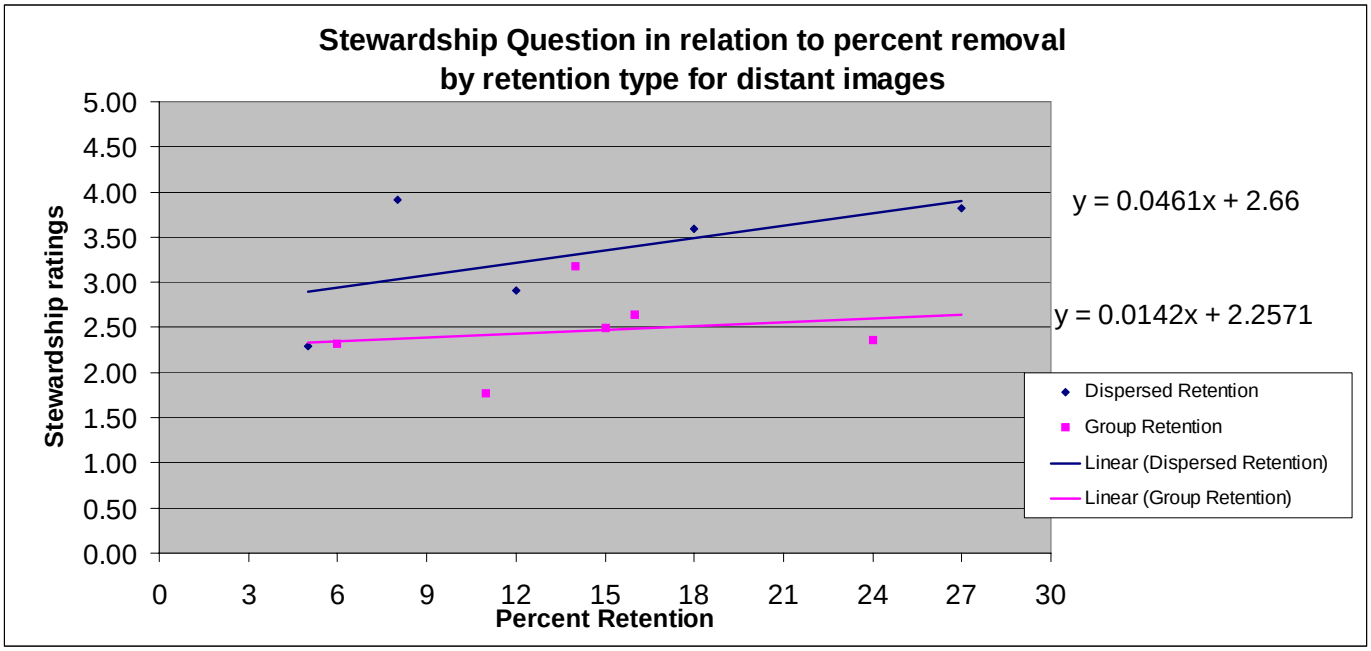

Figure 5: Visible stewardship (visible signs of care) results and regression analysis, showing that as retention levels increase, respondents get the sense that forest managers care more about the land they manage.

In addition to these results, more specific indications of which elements in the landscape affect perceived care (or lack thereof) for the places shown can be obtained from the answers to the open-ended question. These results are listed in Tables 4 and 5.

Features that show care for the land:

Clumps of trees left behind; dispersed trees left behind; variable edges, i.e. not just cutting out a "box" shape

Some places look scenic, very green, organized

Irregular shaping of the managed (cut area); density of the cut evenly distributed throughout the area managed

If they put to practice findings on succession, animal habitat and forest fires. I think the edges of clearcuts are more prone to fires and wind…so less surface area may be better. I don't know if patches or individ. Trees in the middle are helping succession or fires or exacerbating them. But I guess they make it look nicer.

Leaving sporadic trees remaining in a lot. (Dispersed throughout)

Selective cutting depending on the age or girth of the tree suggests, managers care about places they are managing.

Forestry when consideration is taken to the geographical and environmental surroundings including erosion and wildlife.

Leaving groups of trees in logged areas. Not clearing steep hillsides. Letting surrounding growth that has been logged recover before more logging.

When trees are "thinned" not irradicated shows some ecological concern. Also, when there are not excessive truck roads built.

Lack of geometrically square/straight edges; presence of some trees left remaining in logged area; make it look like the surrounding (previously logged?) areas.

Uniform cutting of trees (ie. not cutting big chunks and leaving big chunks); leaving undergrowth, re-planting.

More organic angles. If I see a polygon I'll assume they don't care. Groups of trees left as windbreaks/rain "shields" also denote care.

They care if the place is not totally cleared, but trees are left behind in an ordered matter, either equally spaced or in smaller groups.

Clearcuts seem more visible when you are looking down on them. An even, concentration of trees seems best: no big bald spots.

No stark boundaries between cut and uncut regions; randomly distributed trees left standing (or, to a lesser extent, clumps) amounting to a significant fraction of the "cut region"

Trees remaining evenly dispersed throughout harvested area. Harvested area in a discrete location w.r.t. Surrounding landscape.

The landscape is not stripped bare and more that 50% of the trees are left; also there are no patches of trees being surrounded by a clearcut area.

Evidence of reforestation (large numbers of small trees), logging were many trees were left

1. Keep all those wetland primitely. 2. Barren land where trees are clearly cut is terrible.

Restricted cutting, selective cutting, leaving interval between cutting

1) In what appears to be selective logging the trees are evenly spaced and a certain degree of density is maintained. I am thinking about the needs of the animals, diversity of trees, etc. 2) In some case there were clumps of trees in the midst of open clear cuts. I couldn't figure out the purpose but there appeared to be a plan, flawed as I suspect it is.

Little or very small amount of deforestation; deforested areas not clearcut; trees still present throughout deforested area

Make selective cuts so that trees can grow back by natural reproduction… AND "put back" new trees of various ages to help the forest grow back.

When the landscape is not totally clear-cut but only the density of the trees has decreased. The surrounding environment is untouched.

clean cut area. Replant trees (i.e. cut a whole area of trees down). Don't leave spots of trees standing.

Clear cuts give the impression that managers do not care about the place they are managing. It is better to cut a few trees here and there.

When the area cut is not completely cut but rather is sporadically cut so that there is almost no obvious sign of cutting. Also if there appears to be regrowth in cut areas in the surrounding area.

Some trees left standing in cutting areas; grass/something green (instead of dirt) where the trees used to be.

The dispersion (clumps) of younger trees; Level of organized/disorganized (tidy/gradual/meaningful) landscaping.

The scenery looks perfect, meaning the trees are nicely trimmed, the water looks clean and there aren't any branches cut off or in an odd place. The scene looks lovely.

I think the managers care about the place: If I sees a place where that is clearly not clearcutted, that is, there are many groups of trees left over in an area. In addition, if I see new trees growing in the logging area.

No bald spots, full of trees, some trace of effort to regenerate forest (ie. Young trees, etc)

Appearance of the general area – i.e. appearance of minimal impact where trees have been cut down, attempt to minimize wide swaths of cutting in favour of interspersed or selective cutting, also minimal # of or size of logging/equipment roads through area.

Some (more than 2) small portions of forest are left there in the clearcut area; only cut down a couple of trees in a region.

Uniform tree density over entire region; no clearcuts on steep hills; especially beside rivers/streams; signs of re-planting or new growth

Table 4: Features that show **signs of care** for the land as perceived by the respondents (raw data).

Features that show no care for the land:

Complete elimination of everything in the area; ugly box cut-outs; distinct roads left behind
Forests look messy & big areas are logged
Large, regularly shaped, barren swaths; token groups of trees left behind in clumps, rather than an even distribution of trees left behind.
Similar to above. If they go against the research for fires/succession they don't care. If clearcuts look ugly but are less prone to fires and "edge effects" then I would rather see them. Also clearcutting on tops of mountains show they don't care because everyone has to see it from where they live.
Completely cutting down all the trees down 1/3 of a mountainside and leaving a few patches so it doesn't look so bad.
Denuding hilltops leads to soil erosion if this is happening that means managers don't care.
Forestry clearcutting on steep slopes, near rivers, potential for erosion, and leaving behind thin trees show don't care.
Large areas clear-cut. Logging around streams and rivers. Logging steep hillsides that will quickly erode.
Scorched earth, unnecessary logging roads.
Large open areas with ugly shapes interrupting an otherwise beautiful landscape; clearcutting on slopes; middle of a steep mountainside.
Lots of dead and dry wood and roads; huge chunks of trees gone, large areas cut.
Polygonal cut shapes, large areas left without plant cover, areas near hilltops left bare denote managerial neglect.
Managers do not care if the area is left bare with no trees whatsoever, and the roads are very visible; a whole patch of land is visible from far.
Roads can sometimes look like jagged gashes. Also when big clumps of trees are left in the middle of a clearcut like little islands.
Stark contrasts between cut and uncut regions; few trees left standing (especially if those that are small).
Large, bare areas. High concentration of harvested areas. Salience of places selected to harvest in large landscape.
The shape of the clearcut is highly geometrical, the tree patches are left,
Man made large open areas, erosion, visible roads and tracks from vehicles.
1. Scientific use of forestry resources is necessary for our society and human being.
Clearcutting, big area cutting. Mountaintop cutting that is difficult for regeneration of forest.
Any space that is wide open clearcut indicates a lack of caring. Clear-cut spaces with clumps of trees may be focused on soil erosion. In terms of wildlife, however, there is little consideration. In general, except for a few images, I found the images to be depressing.
To me, areas with clearcutting were an indication that the forest manager responsible for the area did not care much about the area.
Cutting everything; leaving dead trees rot on the ground or fragment of trees; damaging the ground with vehicles or machinery.
Clearcut, surrounding was clearcut previously.
Cut bunch of trees on spots and leave little spots not cut.
Completely empty areas (even if they are small) suggest that managers don't care.
A complete cut in the area where maybe only a few chunks of trees are left. When the soil is shown with pieces of trees strewn about.
Complete clearcutting; no replanting effort or no trees left standing; garbage strewn about where trees used to be.
The distances (voids) between the forested areas; order and estimated quantity of cut-down logs; indications of slope movements/erosions/clearcutting.
There are lots of empty patches where it's just soil or it's stumpy everywhere. There aren't any new trees growing.
If I sees a large area being clearcutted, or if there are many cutting (logging) sites on a same mountain then I think the managers do not care about the place.
Absolutely no trees in some area, when forest does not look full (ie. Too much space between trees)
No attempt to leave any trees standing in a given area, distinct and/or many roads/paths for equipment, overt clearcutting, absence of low-growing foliage.
Have a clearcut (no trees left); have a clearcut, but one tree left per a certain area; those trees will die very soon.
Large, clearcut spots; all trees taken out only where conveniently beside the road; big clearcuts on steep hillsides.

Table 5: Features that show **signs of no care** for the land as perceived by the respondents (raw data).

3.5 Between question correlation

Another key point of interest was whether or not the questions were testing for different things, and in particular, if visual acceptability and visible stewardship are closely related. In order to address this issue, correlations (Pearson's correlation coefficient) were assessed between responses to the two dimensions, and analysis of variance was undertaken. Results (shown in more detail in Figure 6 and Table 6) show that acceptability ratings and visible stewardship ratings correlated with each other quite strongly (Pearson's R = 0.952). The analysis of variance results showed no significant difference in responses to the two questions asked, given that the calculated F value is smaller than the critical F value. Therefore in this context, acceptability and visible stewardship are strongly associated.

ANOVA Single Factor test:

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Stewardship	14	40.29412	2.878151	0.381802
Acceptability	14	36.45637	2.604027	0.512351

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0.52601	1	0.52601	1.176556	0.288014	4.2252
Within Groups	11.62398	26	0.447076			
Total	12.14999	27				

Table 6: One-way analysis of variance output testing for differences on the ratings between the acceptability question and the visible stewardship questions.

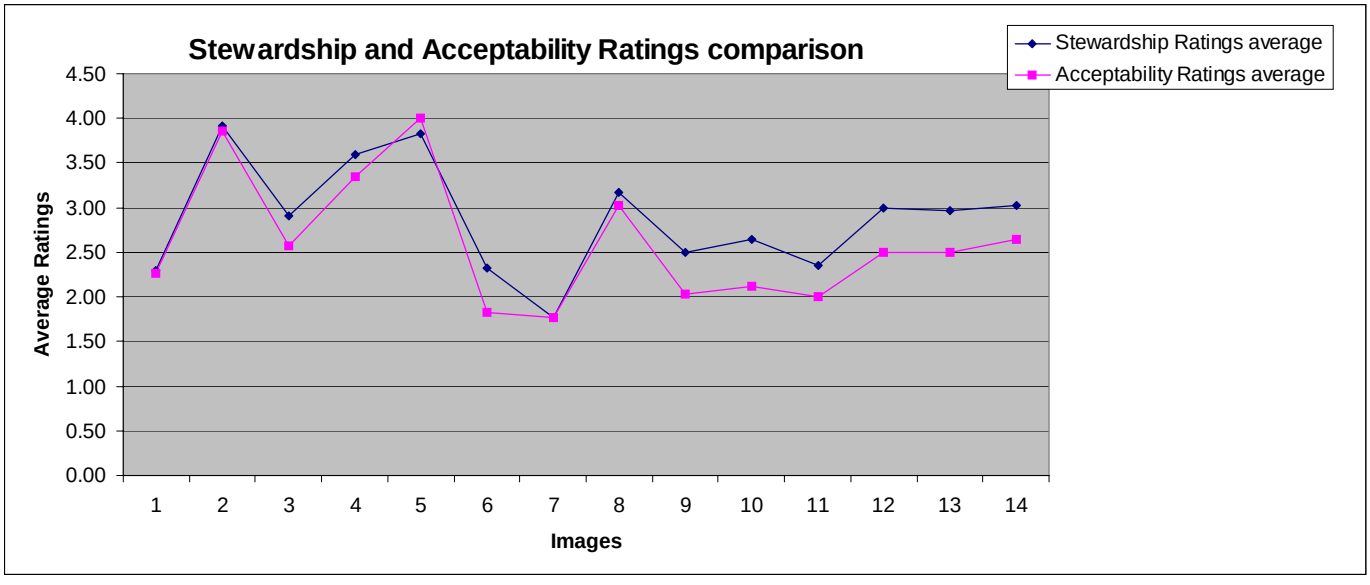

Figure 6: Acceptability ratings versus visible stewardship ratings, showing strong correlations for the 14 images shown (Pearson's R = 0.952).

4.0 DISCUSSION

4.1 Assessment of the methodology used

A number of considerations relating to the performance and limitations of the methodology used need to be discussed. First, it appears that the number of respondents sampled, combined with the experimental design used, proved adequate to derive some meaningful findings from the study. Also, it appears that the question ordering did not have any effect, which means that future similar experiments can be more secure in using such lab arrangements and questionnaire formats without powerful ordering effects. The research design appears to permit at least some thresholds in visual landscape relationships to be clearly defined.

However, some caveats, limitations and assumptions should be kept in mind when reviewing the results obtained and recommendations made below. First, the use of real-world photography, despite extensive efforts to limit variability, resulted in a dataset which contained a wide variety of landscapes, slopes, view angles, forest types, etc. These variations, though typical of actual forest conditions in Northern Vancouver Island that the public might see (from elevated viewpoints or low-flying airplanes), have the potential to introduce unwanted variability in the dataset and findings; more definitive results in pinpointing thresholds could be expected where such variation was minimized. This suggests value in more systematic and controlled field photography, and in the use of state-of-the-art visualization techniques to provide controlled sets of images (see below).

Second, the percent retention figures used in the present analysis were calculated by somewhat different measures for each retention type. Retention by area (and/or percent alteration) is considered the best measure to use with clearcutting or aggregated retention, since area treated/cut is at the root of the percent alteration figures, via the plan-to-perspective concept used by BCMoF (1998). However, this measure is not well suited to dispersed retention, since it becomes very difficult to distinguish between “open” and “canopied” areas when individual trees are so scattered. Consequently, and consistent with past BCMoF research which found that percent basal area retained was the best predictor of scenic beauty (BCMoF, 1997) when partial cutting was used, retention levels for dispersed retention were measured by basal area left (in percent) or in trees per hectare retained. Using two different methods of computing retention levels for the different retention patterns may result in some level of unwanted variability in the dataset.

A further complication, not discussed in depth here, is that the source of the percent retention figure (the independent variable) may have additional unwanted variation within it. In this experiment, the stated percent retention levels provided by Weyerhaeuser, whether calculated by area or by basal area/number of trees removed, related to the block as they defined in spatially; this block may or may not correspond closely to the actual cutblock edge as perceived in the photographs. While the researchers attempted to neutralize this factor by adjusting the retention level to match more closely the visual block outline, some inaccuracy is unavoidable here, particularly with dispersed retention examples where the visible block boundaries are hard to define. As a particularly extreme example of this, a closer look at the data shows that one image in particular was assessed at 8% dispersed retention, though it looked more like 25% retention in the photograph. This may have distorted the results obtained, given the relatively small sample of sites available for the study. If this particular image was removed, the acceptability threshold for dispersed retention would rise to 12.6% retention from 9%. This may argue for more latitude in

interpreting the thresholds identified, although even at this figure, the necessary retention level with dispersed harvesting pattern would still be much lower than the 31% needed with group retention.

The lack of significance in the results pertaining to public perceptions of clearcutting could be due to the importance of harvesting design and view angle, and differences in the spatial configuration of leave [patches: whether retention patches are concentrated together (potentially leaving areas without retention) or whether they are evenly distributed throughout the harvest unit. For instance, a large retention patch left in the middle and in the front of the harvest unit (from the observer's perspective) might be expected to make a big difference in the perception ratings, as opposed to an equivalent patch left on the side and in the background of the unit. As mentioned above, systematic testing using advanced computer visualizations should provide stronger results on public perceptions of whether a variable retention unit is seen as clearcutting.

In addition, the use of a large sample of sites/images and subjects may be necessary to determine more conclusive findings in the questions about distinction from clearcutting and on visible stewardship. The results may also apply most stringently to aerial and high elevation views, and may need some adaptation for the typical range of ground level views and foreground views.

4.2 Implications for forest practices

One of the most interesting findings is the significant difference between acceptability ratings of dispersed retention and grouped retention for retention levels above 3%. Acceptability thresholds seem to be much higher for a given level of tree removal with dispersed retention than with aggregated retention. Figure 4 is probably one of the most interesting figures obtained as part of this research project, in that it clearly indicates that the public perceives the types or patterns of retention very differently. These results are of crucial importance to forest managers in need of meeting public acceptability requirements given that they clearly indicate the need to retain fewer trees on a harvest unit when dispersed retention is used. The results could also have major implications for timber supply calculations as well as for the management of visual resources in general as indicated by Picard (2002). Results suggest that perhaps 2-3 times fewer trees could be left onsite when dispersed retention is used (eg. 9-13% retention for dispersed retention versus 31% retention for group retention, at the point of more than 50% of respondents finding harvesting acceptable).

The acceptability thresholds suggested by these results (see Figure 4), of roughly 5-15% retention with dispersed retention, and roughly 15-70% retention with group retention, suggest two other implications for forest managers:

1) That there may be relatively little overlap between the two harvesting patterns in achieving a desired level of public acceptance; and
2) That there may be much greater certainty in achieving a desired level of public acceptability with dispersed retention than with group retention, where there are clearly many more factors contributing to the range in retention level needed to be acceptable.

However, as cautioned above, more studies and practical tests in the field should be conducted before these thresholds should be adopted.

If the apparent (but as yet unsubstantiated) relationships between the recognition of a clearcut and levels/types of retention were to be borne out in further research or practice, there would be some value in a rule of thumb that suggests that a given percentage of retention (eg. 20% with group retention harvesting) is necessary to convince a majority of people that variable retention is not the same as clearcutting. This could also have implications for management decision-making, given the kind of images used in the media by various interest groups (on all sides) to support arguments for the sustainability (or otherwise) of forest harvesting operations (Sheppard, 2003).

The finding that visible stewardship and acceptability appear to be closely related strengthens the theory that signs of care are a major factor in people's judgments of forestry. The open-ended comments of respondents on this topic provide a rich source of guidelines for the manager. They not only tend to corroborate some of the landscape design guidelines developed on more strictly aesthetic grounds by others such as Lucas (1991), BCMOF (1994), and Bradley (1996), but also can be extended to support the use if more obvious signs of stewardship such as onsite signage, locally-based information programmes, and visible site maintenance/ecological restoration programmes.

4.3 Recommendations for future research endeavors

The final results derived from this research project should contribute to the development of crucial tools and guidelines to aid decision-making for variable retention cutblock design. However, the value of this work could be further enhanced by the undertaking of extended research work as briefly described here:

More systematic and controlled field photography (both aerial and ground-based) would be advantageous, followed by the application of state-of-the-art visualization techniques in order to replicate the existing photography and to provide controlled sets of images with varying levels of retention and slope/angle of view; these should provide the basis for more systematic perception testing to validate and confirm more defined perceptual thresholds of the types discussed in this research report. Such research is continuing at CALP's facilities at the University of British Columbia.

- Consideration should be given to corroborating the ratings of students with that of a sample of adults representative of the BC population (based on census data for example) since such samples have already been used by the BCMoF (e.g. BCMoF, 1996, 1997). This would allow for potential bridging of several research efforts, and could allow for comparisons to be made overtime, since some of the BCMoF data extends back almost 10 years. Such comparisons would allow the investigation of potential trends in the BC perceptual opinions, which would prove very valuable to forest managers.

- Further investigate the various variables used in expressing the level and pattern of retention left on a given block in order to refine our understanding of the interaction between those variables (e.g. retention by area, retention by basal area, retention by volume, etc.) and to pin-point the best predictor variables for public perceptions of various intensities and types of variable retention harvesting.

- There is a need to gather data on a wider range of harvesting techniques, as some types of harvesting are harder to find than others, on similar slopes, forest types (second growth versus old growth), etc.

- Further investigation of the relationships between visual stewardship, acceptability, scenic beauty, and other key dimensions would be helpful in teasing apart which are the best predictors of public acceptability and in what conditions these dimensions measure different things.

- The impact of variable retention over time and with second and subsequent passes should be investigated, perhaps most usefully by means of calibrated visualisations depicting projected scenarios.

- Other factors affecting the visibility and aesthetic quality of variable retention should be investigated, such as windthrow, pests, and variations in regeneration.

It appears as though continuing variable retention harvesting, as well monitoring of existing harvesting units, would be a fruitful area of further long-term research, in order to link the experimental results obtained in research such as described here, with the experiences of forest managers working in the community and with actual perceptions gathered from local communities and visiting publics.

5.0 CONCLUSIONS

In conclusion, the research project described in this paper allowed for an extensive review of Weyerhaeuser's variable retention projects on Vancouver Island, and has contributed to the process of identifying and filling data gaps in research and practice. On this relatively new set of forest practices. A specific methodology and research design for the testing of public perceptions tailored to the variables of interest in this research project and to the variable retention harvesting approach used by Weyerhaeuser was also developed and successfully tested.

Results from the analysis undertaken shed light on public perceptions of variable retention harvesting and provide guidance for future research endeavors. It appears from the results obtained in this project that both the retention level and retention type (or harvesting pattern) can have a significant impact on public acceptability perceptions, and that acceptability thresholds are significantly lower with dispersed retention than when group retention is used. Initial thresholds for acceptability with dispersed and group retention practices are proposed, for future testing and confirmation or adaptation. Future research endeavors, as well as on-the-ground monitoring, should try and replicate these thresholds in order to confirm them. This is crucial to the monitoring and assessment of social criteria and indicators in ongoing certification and adaptive management programs for sustainable forestry. Initial evidence has been found suggesting that perceptions of variable retention as distinct from (or the same as) clearcutting may be predictable, based on more information on retention levels and patterns. Early evidence has also been obtained that visible stewardship or obvious care of place can be expressed differently by different harvesting practices, and that it an be correlated with both the level of retention and the overall acceptability of harvesting to people.

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