FOREST RECREATION

A First Look at Visually Effective Green-up in British Columbia

A Public Perception Study

Recreation Branch
Technical Report 1994: 1

Province of
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of Forests

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Contents

Foreword

British Columbia's world renowned landscapes are a source of everyday enjoyment for residents, as well as a foundation for our tourism industry.

Accordingly, the B.C. Forest Service is developing visual landscape management guidelines and practices to address rising public concern over the visual and aesthetic impacts of forest practices and other developments on B.C.'s scenic landscapes.

The Forest Service undertook this study to gain a better understanding of public perceptions regarding green-up after logging. The results will assist recreation and resource managers in developing visual landscape management guidelines for public forest lands.

This report documents and interprets the results of two studies conducted across British Columbia, where audiences were shown photographs of a wide range of summer and winter green-up conditions.

The Summary highlights the key study findings.

Section 1 intoduces the study and presents the objectives.

Section 2 describes the methodology.

Section 3 presents the results, including sample photographs, and a statistical analysis of the results.

Section 4 presents the conclusions.

Written comments on this report may be sent to:

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Summary

This study was undertaken by the recreation branch of the B.C. Forest Service to gain a better understanding of public perceptions regarding visually effective green-up (VEG) after logging.

In general terms, this study was undertaken to answer two main questions:

- What are the best factors for predicting whether or not the public will consider an area visually greened-up after logging?; and
- how long does it normally take for this green-up to happen?

The study examined VEG in four biogeoclimatic subzones of B.C. during summer and winter conditions. This report documents the study results and presents some initial conclusions.

Key results and conclusions

1. **VEG defined:**
   A working definition of VEG has been established as follows:
   Visually Effective Green-up is the stage at which regeneration is seen by the public as newly established forest.

   When VEG is achieved the forest cover generally blocks views of tree stumps, logging debris and bare ground.

   Distinctions in height, colour, and texture may remain between a cutblock and adjacent forest but the cutblock will no longer be seen as recently cut-over.
2. **Predictive factor identified:**
   Stand height[1] was found to be the best biophysical variable, of those assessed, for predicting VEG.

   Initial results (for the range of conditions studied) indicate that VEG can be achieved by stands between 3 metres to 10 metres high, depending on site-specific characteristics.
3. **Probability of VEG determined:**
   Probability curves were found to be the best way to express the relationship between VEG and stand height. These preliminary curves are not intended for application to all forest lands in B.C.

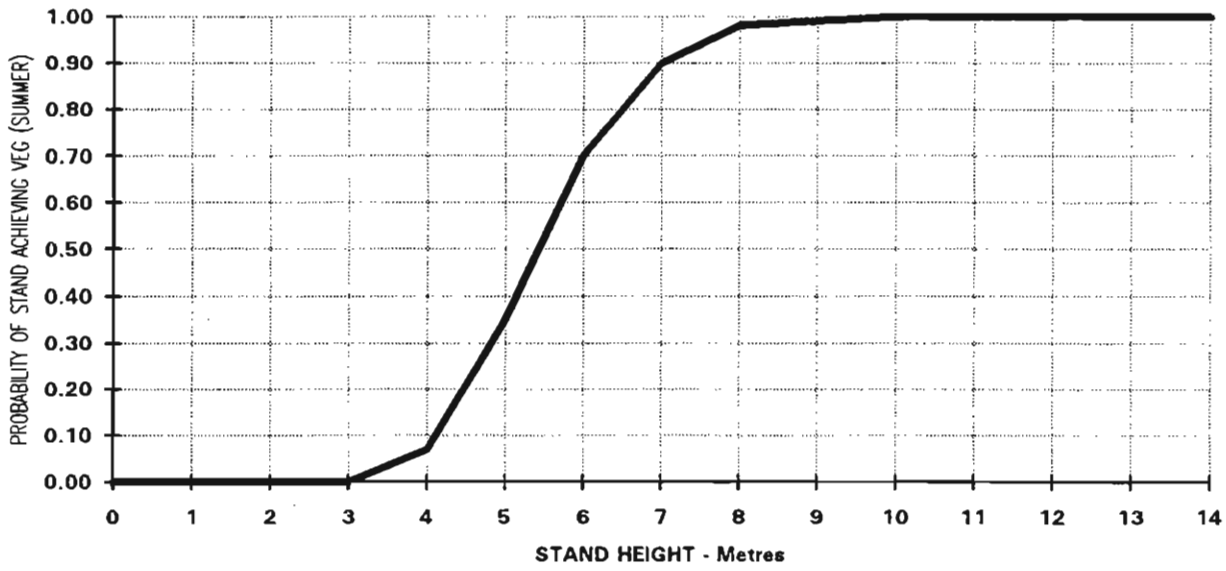
   The VEG curves were developed from an analysis of the results for both summer and winter conditions *(see graphs on following page).*

   For example, based on the VEG curve for summer conditions, the probability of VEG on study sites was found to be as follows:
   - for stands under 4 metres high the probability of VEG is less than 10%
   - the probability of VEG increases to about:
     - 35% for 5 metre high stands,
     - 50% for 5.5 metre high stands,
     - 70% for 6 metre high stands.
4. **Years to reach VEG estimated:**
   VEG probability curves, when used in conjunction with growth curves, can assist in estimating the time required for a given stand to reach VEG. An example, prepared specifically for the study sites, is provided in Section 4.2.

   Variations can be expected in the time required to reach VEG across a wide range of site conditions, such as slope and depth of soil, different productivity ratings, and various biogeoclimatic zones.

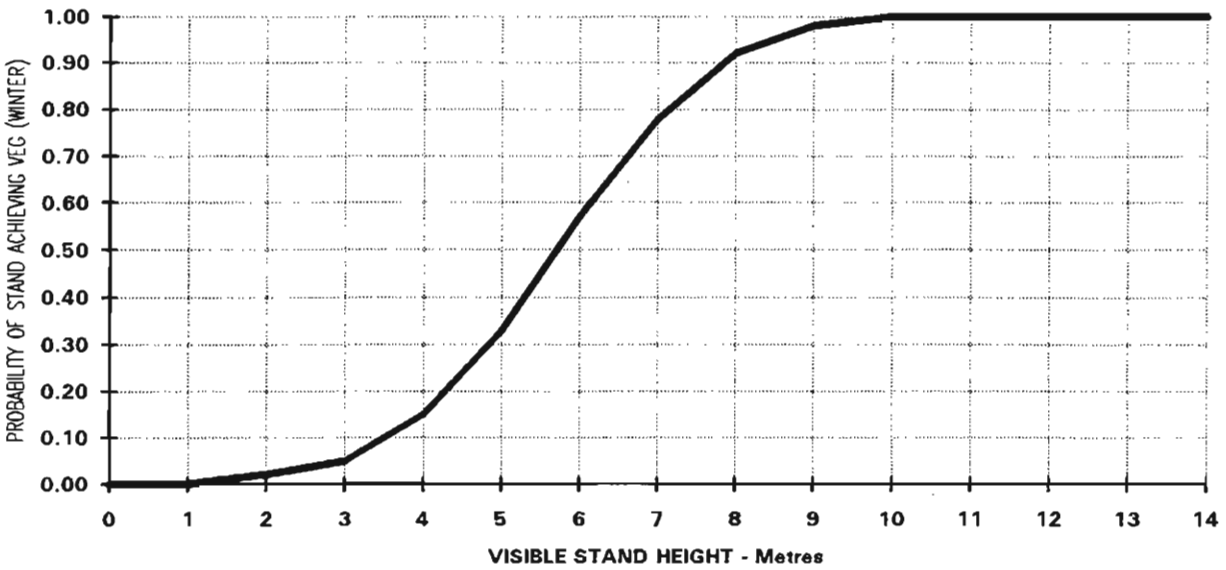
[1] Stand height is defined as the average height of the 100 largest diameter trees per hectare in a stand.

Probability of VEG in relation to stand height (summer conditions):



**Small sample sizes may give results that are not totally representative statistically.*

Probability of VEG in relation to visible stand height (winter conditions):



**Small sample sizes may give results that are not totally representative statistically.*

Limitations of the study

This study represents only a first look at VEG within the expanding field of visual landscape management in B.C.

As such, there are necessarily limitations to this public perception study. The key ones are:

1. Only a few representative sites where sampled. The study does not represent the full-range of stand types, site characteristics and biogeoclimatic zones in B.C.
2. The study does not represent all views in the field. For example, very few flat sites were sampled, since they are not highly visually sensitive.
3. The working definition for VEG is necessarily subjective. For this study, the mid-range in mean scores is considered the cut-off line between VEG and not VEG.

Use of the results:

The findings on VEG presented in this study will generally assist resource managers in predicting when a logged area should reach VEG. This will help to determine when nearby areas within a landscape unit may be logged.

More specifically, the results and conclusions of this study, including the VEG probability curves, can:

- be incorporated into visual landscape management guidelines currently being developed;
- be used in the Ministry's current Timber Supply Review; and,
- assist in visual landscape assessments, design, and planning of forest practices over time and space.

1.0 Introduction

Managing Visual Landscapes

The B.C. Forest Service's goal for managing visual landscapes is *to ensure that the levels of visual quality expected by society are achieved on all public forest lands in keeping with the concepts and principles of integrated resource management.* Integrated resource management is a process to identify, assess and compare all resource values as a basis for making resource management decisions.

The primary focus of visual landscape management is to mitigate the visual impacts of forest practices, including timber harvesting and road building. Approximately 85% of the timber harvested in British Columbia today is logged using clearcutting methods. About 30% of B.C.'s commercial timber is in visually sensitive areas, such as steep slopes along travel corridors through mountainous regions or adjacent to waterways.

Since the visual resources of provincial forests are highly valued by the public, the Forest Service is interested in learning about and understanding the public's landscape preferences.

The Forest Service recreation branch undertook this study to gain a better understanding of public perceptions regarding green-up after logging. In general terms, this study was undertaken to answer two main questions:

- What are the best factors for predicting whether or not the public will consider an area visually greened-up after logging?; and,
- how long does it normally take for this green-up to happen?

1.1 Objectives

The objectives of this study were to:

- Establish a working definition for Visually Effective Greenup (VEG)
- Determine the biophysical conditions required for a previously harvested area to reach a state of VEG, in both summer and winter conditions
- Relate VEG to viewing factors, site characteristics, biogeoclimatic and physical conditions, silvicultural and harvesting systems, and post harvest treatments
- Establish ways of predicting the time required between regeneration and VEG

1.2 Terminology

Visually Effective Green-up (VEG) is the stage at which regeneration is seen by the public as newly established forest.

When VEG is achieved the forest cover generally blocks views of tree stumps, logging debris and bare ground.

Distinctions in height, colour, and texture may remain between a cutblock and adjacent forest but the cutblock will no longer be seen as recently cut-over.

Green-up: an overview

Green-up is a general term referring to the concept of returning to, or achieving, a desired state. There are various types of green-up, as follows:

Free growing crop or free-to-grow: A crop of healthy trees, the growth of which is not impeded by competition from plants, shrubs or other trees. (*Forest Act, 1987*)

Hydrologic green-up: The point at which a second growth stand of timber will hydrologically resemble old growth (i.e., in terms of timing and quantity of water yield) *(e.g., Okanagan TSA Timber Harvesting Guidelines, MoF).*

Visual Cover or Visual Green-up: A term used by wildlife specialists when referring to security cover, or a stand's ability to provide cover from human disturbance and threat of predators, particularly for deer and elk. The height, density and diameter of the overstory, the density of the understory, and the diversity of the topography determine a stand's ability to provide security cover *(e.g., Integrated Wildlife-Intensive Forestry Research Program).*

Visually Effective Green-up (VEG): the stage at which regeneration is perceived by the public as newly established forest *(this study).*

2.0 Methodology

2.1 Overview

The VEG study was carried out by taking a number of photographs of previously logged areas during both summer and winter conditions. The photographs were then assessed for common biophysical characteristics that could be used to predict VEG, such as stand height, slope, terrain, etc. The photographs were shown to several audiences and people were asked to rate each photograph on a scale of 1-5 in response to the question, *"To what degree does the disturbed area appear to be greened-up?"*

The results were analyzed to determine the most suitable biophysical characteristic for predicting VEG, which turned out to be stand height. The results were further analyzed to determine the probability of VEG in relation to stand height, yielding the VEG curves presented in this report (see section 4.1).

2.2 Detailed discussion

The study had two distinct components: summer VEG and winter VEG. Both summer and winter VEG were studied in four distinct phases, as follows:

2.2.1 Phase I: Photography:

Photographs were taken of harvested sites at mid-ground distances (1-8 km). Each photograph was intentionally "zoomed-in" on a particular cutblock to eliminate distracting views of sky, water or adjacent cutblocks as much as possible.

Summer VEG:

- 140 photographs were used, sampling a range of summer conditions and biophysical attributes in four biogeoclimatic subzones (limited to four due to resources). 136 sampled clear cuts and 4 sampled partial cuts.
- The four biogeoclimatic subzones where as follows:
  - Columbia-Shuswap Moist Warm Interior Cedar-Hemlock (ICH mw2;a);
  - Hazelton Moist Cold Interior Cedar - Hemlock (ICH mc);
  - Eastern Very Dry Maritime Coastal Western Hemlock (CWH xm1); and,
  - Submontane Very Wet Maritime Coastal Western Hemlock (CWH vm1).

Winter VEG:

- Photographs displayed winter conditions at thirty-five of the sites previously photographed for summer VEG, in two of the biogeoclimatic subzones:
  - Columbia-Shuswap Moist Warm Interior Cedar-Hemlock (ICH mw2;a); and,
  - Hazelton Moist Cold Interior Cedar - Hemlock (ICH mc).

2.2.2 Phase II: Collection of site data

- Forest cover and biophysical site attributes were obtained for all photographed areas. These attributes were collected from Forest Service and/or licensee history records, silviculture opening files, forest cover maps, aerial photographs, ecosystem manuals, and summer and winter field inspections.

Summer VEG
Common biophysical characteristics were identified for the photographs to provide factors that could be used to predict VEG. The responses from the public meetings were later analyzed to determine the most suitable factor.

Photographs were selected to show a range of green up conditions and a range of biophysical site characteristics.

- 24 biophysical variables were identified in the photographs during summer conditons (*see Figure 1).*

Winter VEG:

- 7 biophysical variables were identified in the photographs during winter conditions (*see Figure 2).* These included significant variables selected from the summer study and four new ones characteristic of winter conditions.

2.2.3 Phase III: Public meetings

Summer VEG:

- The study was designed to collect the responses of three target groups that were expected to have statistically different responses: the forestry community, the organized environmental community, and the general public (i.e., individuals not directly affiliated with the other two groups). Participants were invited from 363 organized groups as well as through the local media.
- A total of 550 individuals responded; 201 from the forestry community, 16 from the environmental community, and 333 from the general public.
- The photographs were presented to audiences in twelve B.C. communities: Salmon Arm (test community), Revelstoke, Castlegar, Kelowna, Quesnel, Smithers, Prince George, Port Alberni, Tofino, Campbell River, Whistler/Squamish, and Vancouver.
- Audiences in Salmon Arm, Revelstoke, Castlegar, and Kelowna viewed slides from the ICH mw2,a subzone; Quesnel, Smithers, and Prince George viewed slides from the ICH mc and ICH mw2,a subzones; Port Alberni, Tofino and Campbell River viewed slides from the CWH vm1 subzone; and Vancouver, and Squamish/Whistler viewed slides from the CWH xm1 subzone.
- Each audience viewed 35 of the 140 summer photographs. For each photograph, participants chose one of the following responses to the question, "*To what degree does the disturbed area appear to be greened-up?*":

  1. Not at all
  2. A little
  3. Quite
  4. Very
  5. Fully

Winter VEG:

- All 35 winter photographs were presented to 300 respondents from public audiences in seven B.C. communities: Salmon Arm, Kamloops, Smithers, Prince George, Williams Lake, Chilliwack, and Nelson. Audiences were chosen from community service organizations or clubs not directly affiliated with forestry.
- For each photograph, participants chose one of the following responses to the question, "*To what degree does the disturbed area appear to be greened-up?*":

  1. Not at all
  2. A little
  3. Quite
  4. Very
  5. Fully

2.2.4 Phase IV: Analysis of data

- The responses from the public meetings were statistically analyzed to determine the most suitable factors for predicting VEG.

  Since the majority of variables assessed in this study are categorical versus quantitative the CHAID[2] technique was chosen for this analysis.
- In addition, the probability of both summer and winter VEG, in relation to the height of reforested stands, was determined by using a Linear Regression model[3]. The results of this analysis show the probability of VEG for a range of stand heights.

Rating of VEG in photographs

For analysis purposes, the 5 levels of response for each photograph were assigned a numerical rating. For example, *3 = quite greened-up* and *5 = fully greened-up*.

A mean score was calculated for each photograph from the responses and is referred to as the Mean Green-up Value (GV) Score.

For the purposes of this study, any photograph with a mean score greater than or equal to 3.0 was considered VEG. 3.0 was chosen as the cut-off score, since it is the mid-point in the 1 to 5 range.

Mean Green-up Value (GV) Score: the mean score calculated from all responses for a photograph.
For the purposes of this study, any photograph with a mean GV score greater than or equal to 3.0, from a possible range of 1 - 5, was considered VEG.

[2] CHAID is a loglinear technique that is statistically valid with easy to understand results. CHAID stands for "Chi-square Automatic Interaction Detection." Chi-square is the statistic used in categorical models; "interactions" are associations between variables which should be taken into account for successful prediction; "detection" is what the researcher hopes to do; and "automatic" means that a guided technique is used.

[3] A Linear Regression Analysis produces an equation that allows one to predict values of one dependent variable (in this case, VEG) from known values of one or more independent variables (in this case, stand height).

3.0 Results

3.1 Predicting VEG based on biophysical characteristics

This section reports on biophysical characteristics that were found most useful for predicting VEG.

Summer VEG:

The biophysical variables were ranked in order of their capability for predicting VEG, based on an analysis of the Mean Green-up Values (see Figure 1).

Predictive values represent the probability that two variables are related, thereby giving a measure of the confidence of each variable to predict VEG. The higher the value, the higher the probability that the variable is directly linked to VEG.

Variables below a 0.95 probability are not considered statistically significant and where not analyzed further.

Figure 1: Predictive Value of Biophysical Variables (Summer):

This figure lists the 24 biophysical variables in order of their predictive capability when acting separately from all other variables.

Variable	Predictive Value	Variable	Predictive Value
1. Stand height	0.9999986	13. Aspect	0.6
2. Stand age	0.9999985	14. Site class	0.0
3. Regeneration method	0.999985	15. Stocking status	0.0
4. Existing visual condition	0.9998	16. Freegrowing	0.0
5. Visible roads and site disturbances	0.9995	17. Terrain	0.0
6. Exposed rock and soil	0.999	18. Natural openings	0.0
7. Site preparation method	0.998	19. Natural patterns	0.0
8. Slope position	0.995	20. Visual absorption capability	0.0
9. Slope	0.99	21. Silviculture system	0.0
10. Brush cover	0.95	22. Harvesting method	0.0
11. Viewing angle	0.9	23. Stand treatments	0.0
12. Percent disturbance	0.8	24. Stand density	0.0

Key points for Figure 1:

- tree height and tree age where considered the best predictors of VEG (i.e., they had the highest predictive values)
- ten biophysical variables were considered significant predictors of VEG
- eleven other variables were considered to have no predictive capability for VEG.

Winter VEG

Similar analyses of winter biophysical variables resulted in the following ranking according to predictive value (see Figure 2):

Figure 2: Predictive value of biophysical variables (winter):
Listing of variables according to predictive value when acting separately from all other variables.

Variable	Predictive Value
1. Visible snow	0.999985
2. Stocking	0.99988
3. Visible Stand height	0.969
4. Snow depth	0.84
5. Canopy snow	0.0
6. Visible roads	0.0
7. Slope	0.0

Figure 2 shows:

- of the seven variables assessed, three were statistically significant predictors (predictive value greater than 0.95).
  However, visible snow was dropped from the final analysis because of conflicting results. Correlations with VEG where not consistent across the range of categories from 1: High visible snow to 4: Nil visible snow. (Category 2, moderate visible snow, had 67% VEG while Category 3, low visible snow, had 100% not VEG).
- therefore, stocking and visible stand height were considered the best predictive variables for winter VEG.

3.1.1 Predictive Capability of Variables In Relation to One Another

The result of the CHAID analysis for all variables in all subzones combined is found in Figure 3 and 4. The tree diagrams illustrating the results of this analysis do not necessarily rank the variables in the same order as the lists presented in Figures 1 and 2. The reason for this is that new patterns often emerge when analyses are conducted on subsets of data (for example, a subset would be those photos with stand heights between 0-4.5 metres). When this occurs, certain variables become important in relation to specific subsets. This is illustrated in the following tree diagrams.

Summer VEG Tree Diagram

Figure 3: Predictive capability of biophysical variables: Summer VEG
Tree diagram for all biogeoclimatic subzones using a 3.0 Mean Green-up Value for VEG. All 24 biophysical variables for summer VEG were included in the analysis.

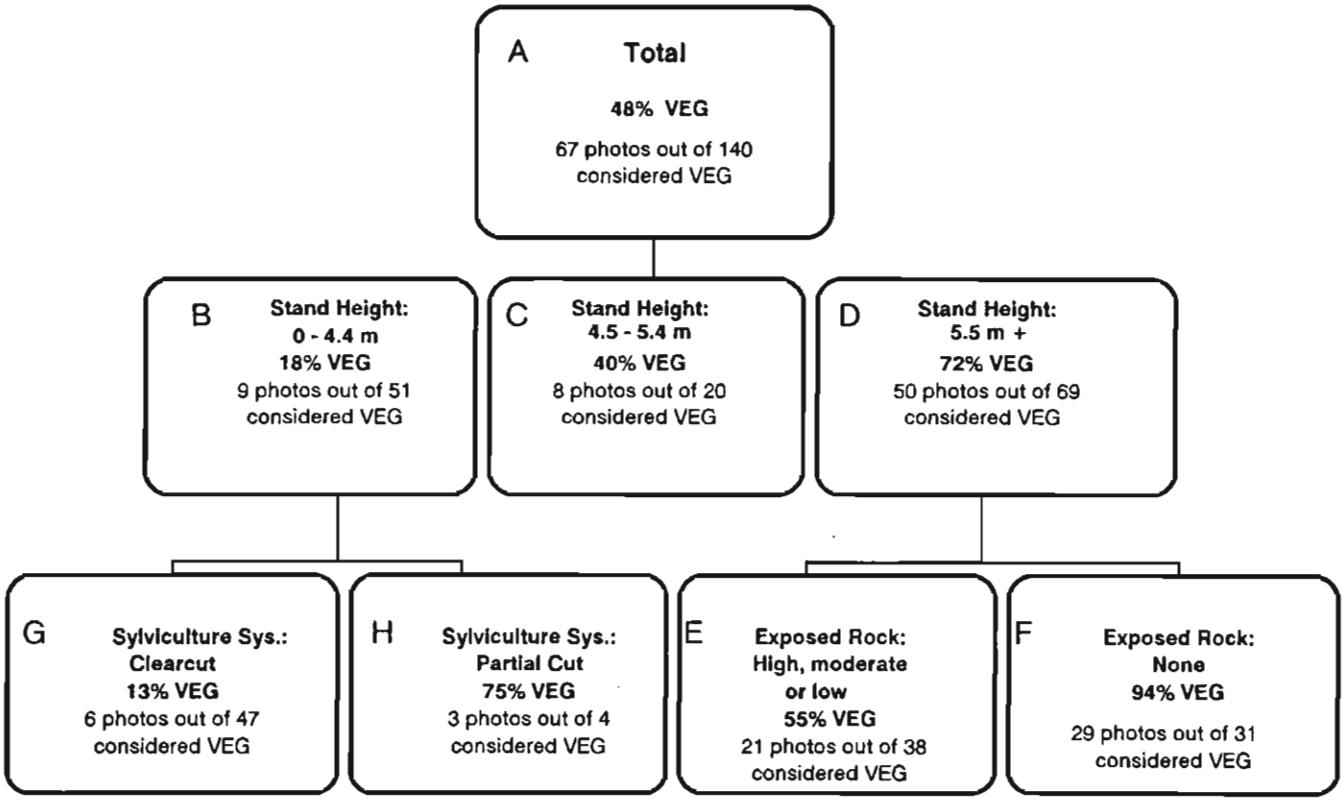


Figure 3 shows:

- referring to box A of the tree diagram; 48% of the 140 photographs were VEG.
- proceeding to the next level down, the biophysical variable that CHAID splits off first is stand height (boxes B,C & D).
- therefore, stand height[4] is the best biophysical variable assessed for predicting summer VEG.
- for the subset of photos with stand heights of 0 to 4.4 metres the next best variable is silvicultural system (i.e., partial cut logging vs. clearcut logging) (boxes G & H).
- for stand heights over 5.5 metres the next best variable is the amount of exposed rock or mineral soil (boxes E & F).

Please note, however, that the other variables can also be important factors at some sites.

Stand height is the best biophysical variable assessed for predicting VEG during summer conditions.

[4] Stand height is the average height of the 100 largest diameter trees per hectare in a regenerated stand.

Winter VEG Tree Diagram:

The result of the CHAID analysis for six biophysical variables for winter VEG is found in Figure 4.

As discussed, visible snow was dropped from the final CHAID analysis because of conflicting results.

Figure 4: Predictive capability of biophysical variables: Winter VEG
Tree diagram for the combined data set (all biogeoclimatic subzones) using a 3.0 Mean Green-up Value cut-off score for VEG. 6 out of 7 variables are included in the analysis; visible snow was dropped due to conflicting results.

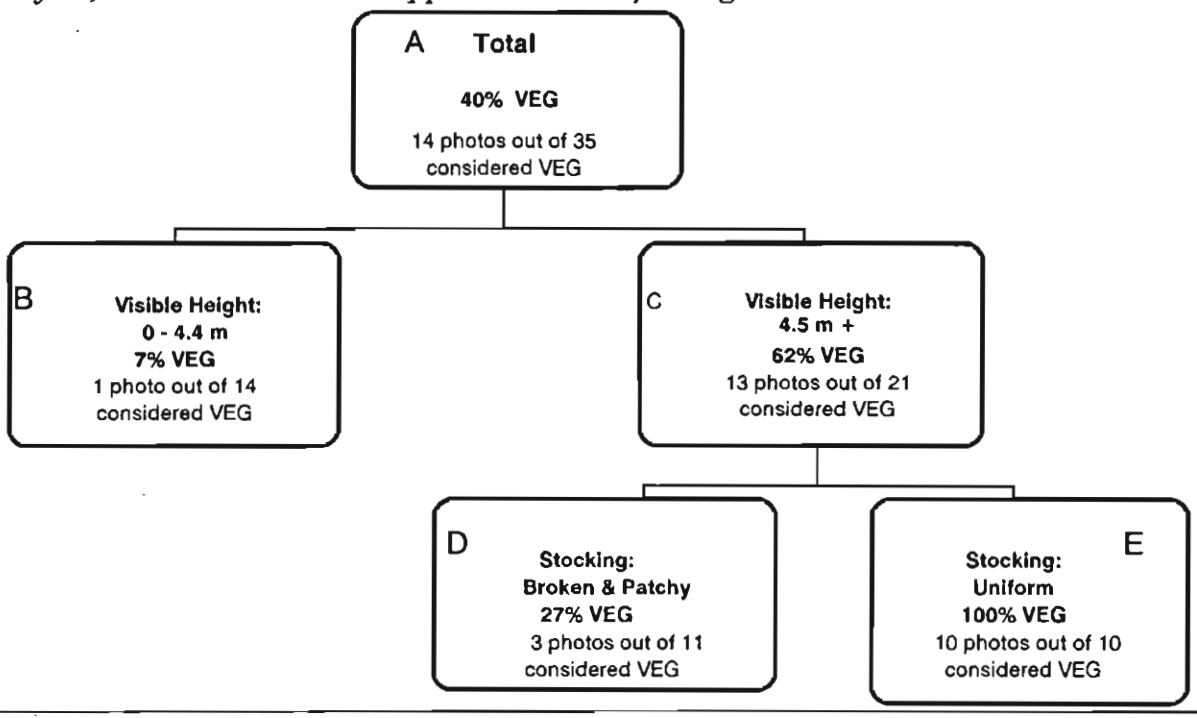


Figure 4 shows:

- referring to box A of the tree diagram; 40% of the 35 photographs were VEG.
- proceeding to the next level down, the biophysical condition variable that CHAID splits off first is visible stand height, or visible height of regenerated trees (boxes B & C).
- therefore, visible stand height[5] is the best biophysical variable assessed for predicting VEG during winter conditions.
- for the subset with visible stand heights over 4.5 metres the next best variable for predicting VEG is stocking of the regenerating stands (i.e., uniform vs. broken or patchy stocking) (boxes D & E).

Please note, however, that the other variables can also be important factors at some sites.

Visible stand height is the best biophysical variable assessed for predicting VEG during winter conditions.

The uniformity of stocking, or the arrangement of trees in a disturbed area, is also a significant variable for determining winter VEG

[5] Visible stand height is the average height above snow pack of the 100 largest diameter trees per hectare in a stand.

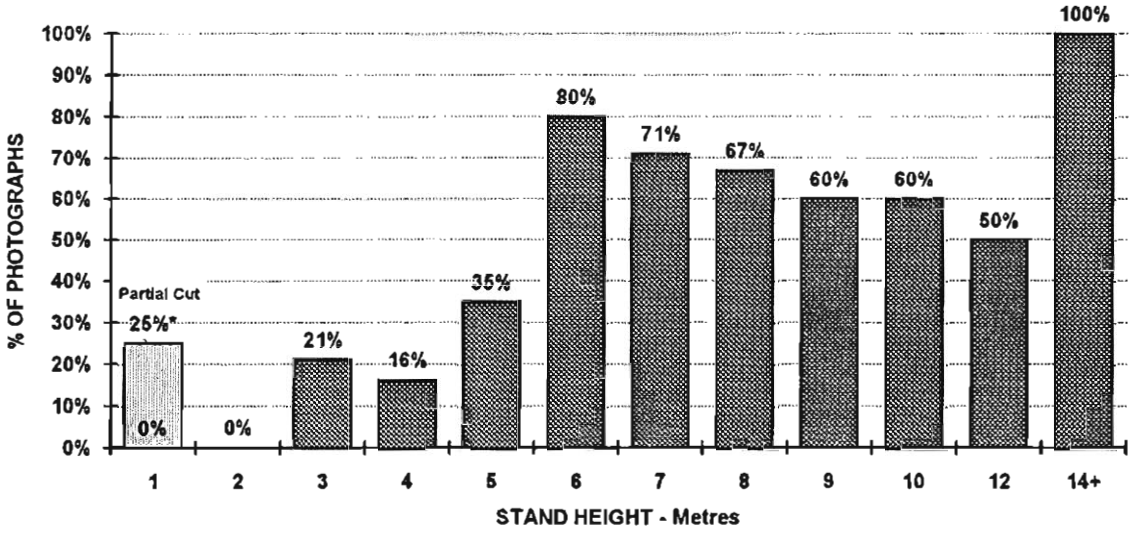
3.2 Relationship between VEG and stand height

This section reports on the percentage of photographs considered VEG in relation to tree height in regenerated stands, during both summer and winter conditions. The results are found in Figures 5 and 6.

Summer VEG:

As discussed, stand height is considered the best biophysical variable, of those assessed, for predicting VEG during summer.

Figure 5: Percentage of photographs showing summer VEG by stand height



Sample size:	12	6	14	19	20	15	17	15	5	5	4	8

* In the 0-1.4 m range, the 25% (3 out of 12) that achieved VEG were all partial cuts.

Key points for Figure 5:

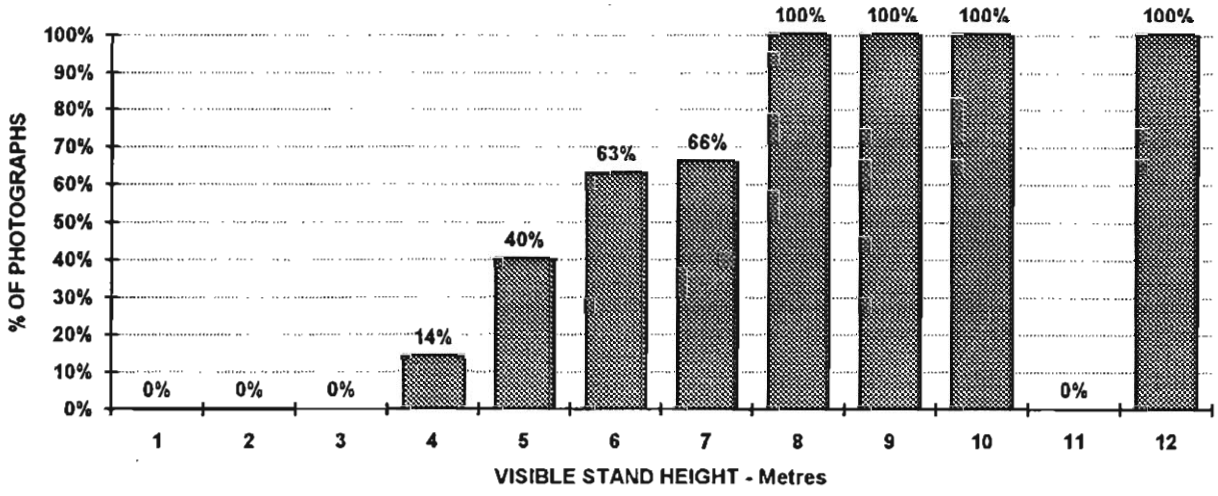
- none of the clearcut stands under 2.5 metres high where considered VEG.
- 3 out of the 4 partial cut stands sampled in the study, or 75%, where considered VEG. (All 4 were considered to be in the 0-1.4 m range.)
- less than 20% of the clearcut stands under 5.5 metres high were considered VEG.

Please note:

- For stands in the 8.5 to 13.4 metre range (height classes 9 to 12) small sample sizes may have given results that are not totally representative.
- Further analysis of this raw data has yielded probability curves that depict the probability of VEG for a range of stand heights (*see the probability curve for summer VEG, figure 7, and the regression analysis curve, Appendix 6.3*).

Winter VEG:
As discussed, stocking and visible stand height (the average height of trees above the snowpack) are the best biophysical variables, of those assessed, for predicting VEG during winter conditions.

Figure 6: Percentage of photographs showing winter VEG by visible stand height



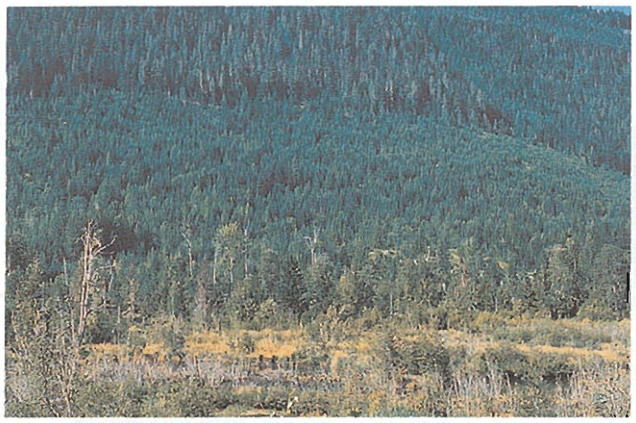
Key points for Figure 6:

- none of the stands with less than 3.5 metres of visible tree height were considered VEG
- less than 16% of the stands with less than 5.5 metres of visible tree height were considered VEG

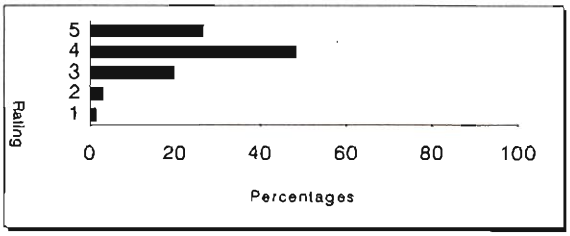
Please note:

- for the 7.5 to 12.4 m stands (height classes 8 to 12), small sample sizes may have given results that are not totally representative.
- Further analysis of this raw data has yielded probability curves that depict the probability of VEG for a range of stand heights (*see the probability curve for winter VEG, figure 8, and the regression analysis, Appendix 6.3*).

3.3 Sample VEG photographs and VEG ratings



Example - VEG rating graph



GV rating: 3.95 **VEG: YES**
Stand height: 10.0m **Age: 17 years**

Factors Influencing VEG*:

[+] varied colours

[+] regeneration beginning to break up back boundary - blends in

*Note: [+] indicates positive influence,
[−] indicates negative influence

Using the VEG photographs:

This page explains how the VEG photographs are organized and what the accompanying data refers to.

VEG Rating Graphs:
For each photograph, participants chose one of the following responses to the question, "*To what degree does the disturbed area appear to be greened-up?*":

1. Not at all
2. A little
3. Quite
4. Very
5. Fully

Each VEG rating graph is a visual depiction of the response for each rating. For example, in the graph above, 50% of the respondents chose "4. Very" and 20% chose "3. Quite" (greened-up).

GV Rating: [Mean Green-up Value (GV) Score] The mean score calculated from all the responses for each photograph.

VEG (Visually Effective Green-up): the stage at which regeneration is perceived by the public as newly established forest.

For the purposes of this study, any photograph with a mean GV score greater than or equal to 3.0, from a possible range of 1-5, was considered VEG. Any photograph with a mean GV score below 3.0 was considered NOT VEG

Stand height: The average height of the 100 largest diameter trees per hectare in a regenerated stand in summer conditions.

Visible stand height: The average height above snow pack of the 100 largest diameter trees per hectare in a stand in winter conditions.

Age: The age of the reforested stand of trees in the photograph.

SAMPLE RANGE OF VEG RATINGS

Photo 1

GV rating: 1.05 VEG: NO

Photo 2

GV rating: 2.00 VEG: NO

Photo 3

GV rating: 3.01 VEG: YES

Photo 4

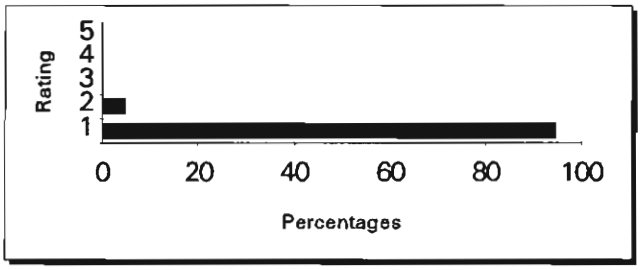
GV rating: 4.02 VEG: YES

Photo 5

GV rating: 4.53 VEG: YES

VEG RATINGS - Summer

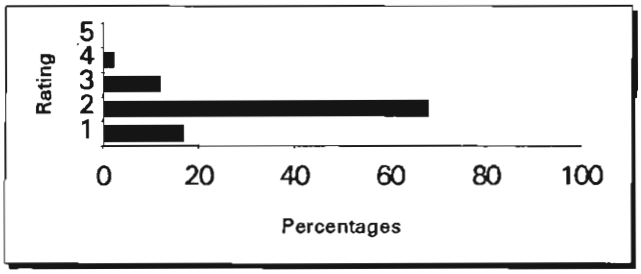
Photo 1



GV rating: 1.05 **VEG: NO**
Stand height: 0.3m **Age: 3 years**

Factors influencing VEG
[–] new clearcut
[–] road cut and mass wasting highly visible

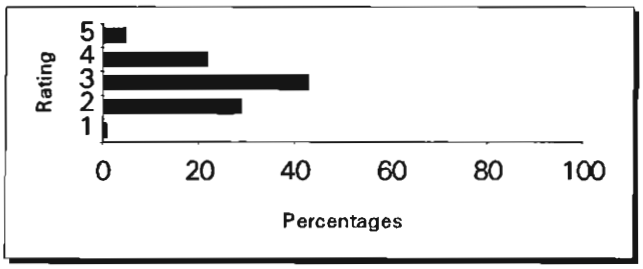
Photo 2



GV rating: 2.00 **VEG: NO**
Stand height: 2.0m **Age: 6 years**

Factors influencing VEG:
[–] road still visible
[–] visually distinct debris and rock on upper boundary

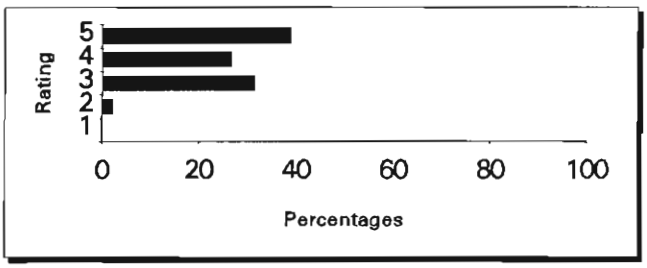
Photo 3



GV rating: 3.01 **VEG: YES**
Stand height: 7.0m **Age: 11 years**

Factors influencing VEG:
[–] road (colour contrast/line) still visible
[–] upper left boundary and upper boundary - ground visible

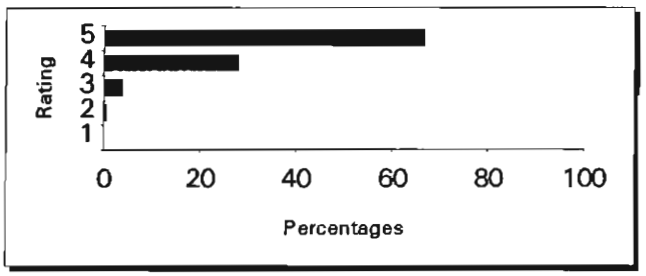
Photo 4



GV rating: 4.02 **VEG: YES**
Stand height: 15.0m **Age: 24 years**

Factors influencing VEG:
[–] colour and texture contrast with top boundary
[+] heavy stocking

Photo 5



GV rating: 4.53 **VEG: YES**
Stand height: 10.0m **Age: 24 years**

Factors influencing VEG:
[+] regeneration blends well with surrounding forest

Range: (1.15 - 1.19)

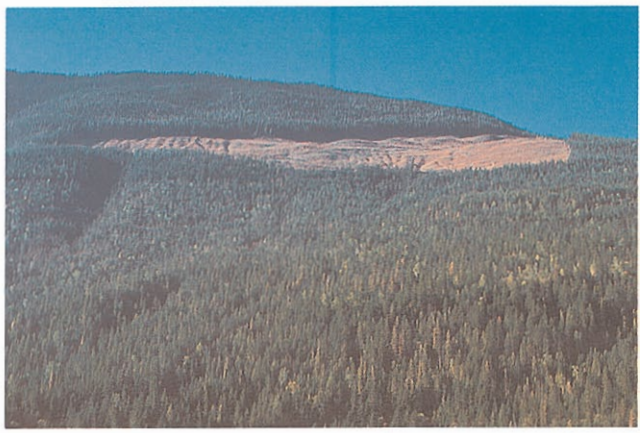
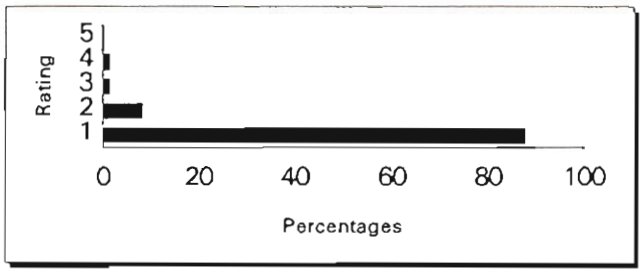


Photo 6



GV rating: 1.15 **Veg: NO**
Stand height: 0.6m **Age: 5 years**

Factors influencing VEG:

[–] new clearcut
[–] colour contrast
[–] square corners and straight edges

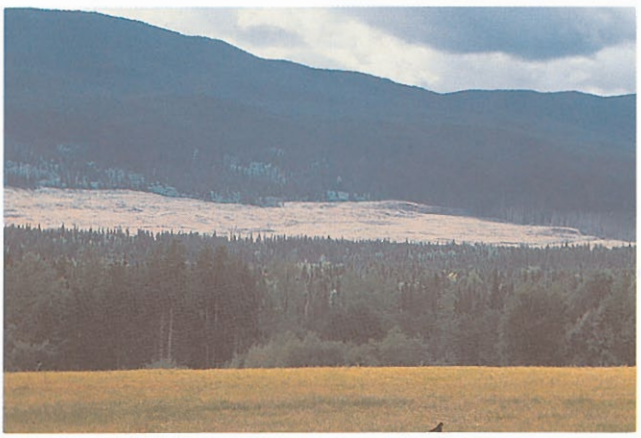
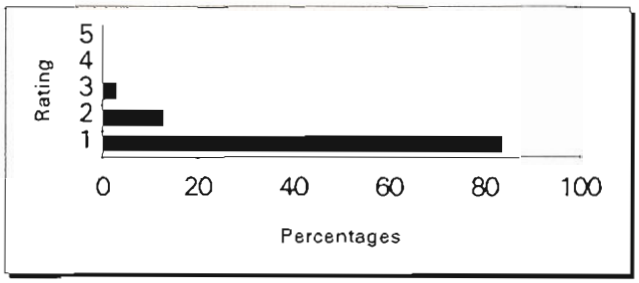


Photo 7



GV rating: 1.19 **Veg: NO**
Stand height: 0.4m **Age: 2 years**

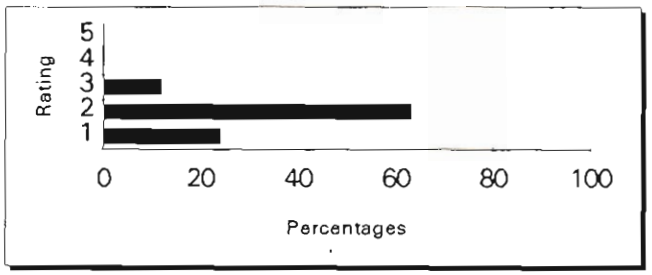
Factors influencing VEG:

[–] new clearcut
[–] colour contrast

VEG RATINGS - Summer

Range: (1.88 - 2.11)

Photo 8



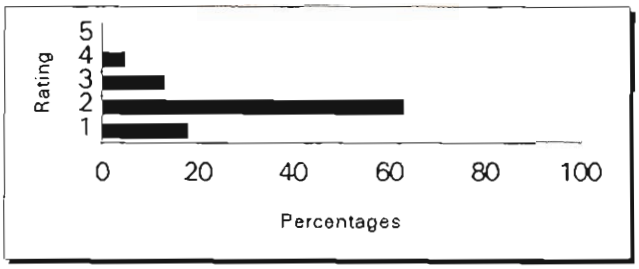
GV rating: 1.88 **Veg: NO**
Stand height: 3.0m **Age: 8 years**

Factors influencing VEG:

[–] road - straight line/colour contrast

[–] sparse regeneration and minimal stand height

Photo 9

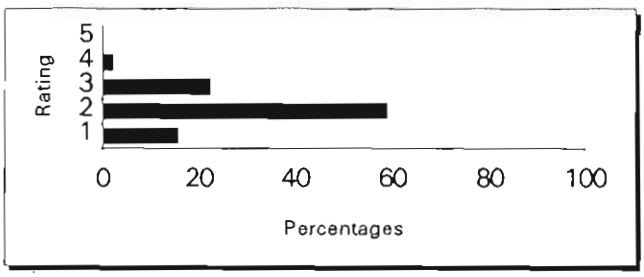


GV rating: 2.05 **Veg: NO**
Stand height: 3.0m **Age: 10 years**

Factors influencing VEG:

[–] couple of small openings visible near edge of lake

Photo 10



GV rating: 2.11 **Veg: NO**
Stand height: 3.5m **Age: 18 years**

Factors influencing VEG:

[–] colour contrast

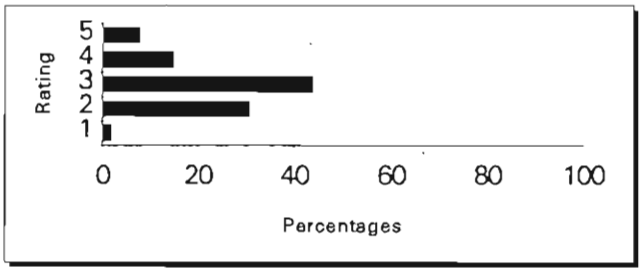
[–] texture difference

[+] uneven boundaries

VEG RATINGS - Summer

Range: (2.96 - 3.07)

Photo 11



GV rating: 2.96 **Veg: NO**
Stand height: 9.0m **Age: 14 years**

Factors influencing VEG

[–] hard dark shadow line on left of block and notched skyline

[–] some ground showing

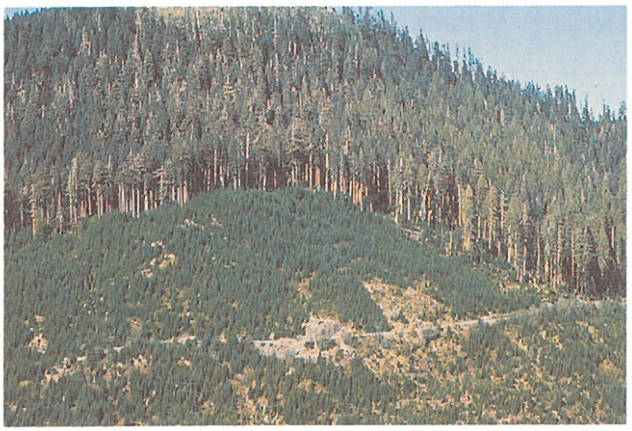
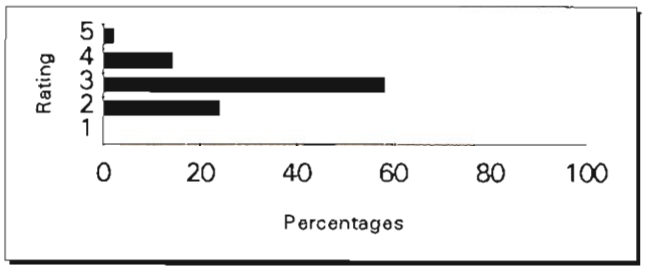


Photo 12



GV rating : 2.95 **Veg: NO**
Stand height: 7.0m **Age: 15 years**

Factors influencing VEG:

[–] road visible

[–] some bare ground

[–] contrast with top boundary

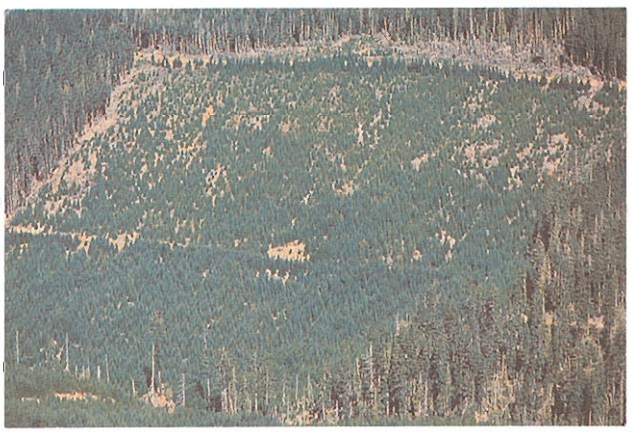
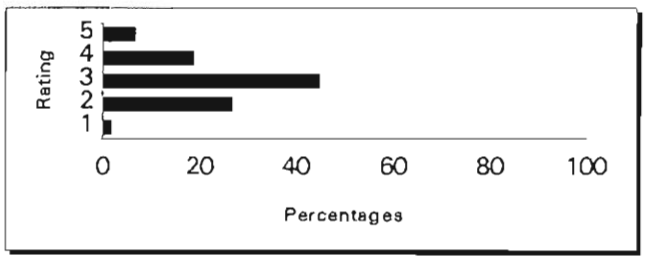


Photo 13



GV rating: 3.02 **Veg: YES**
Stand height: 10.0m **Age: 17 years**

Factors influencing VEG:

[–] square corners

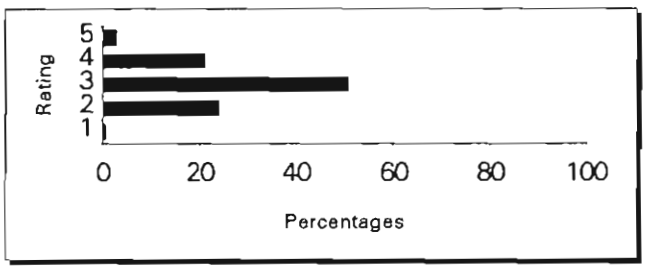
[–] colour contrast on left and top boundaries

[–] some rock and ground showing through

VEG RATINGS - Summer

Range: (2.96 - 3.07) **/...cont'd**

Photo 14



GV rating: 3.02 **Veg: YES**
Stand height: 3.4m **Age: 10 years**

Factors influencing VEG:

[+] texture and colour variation

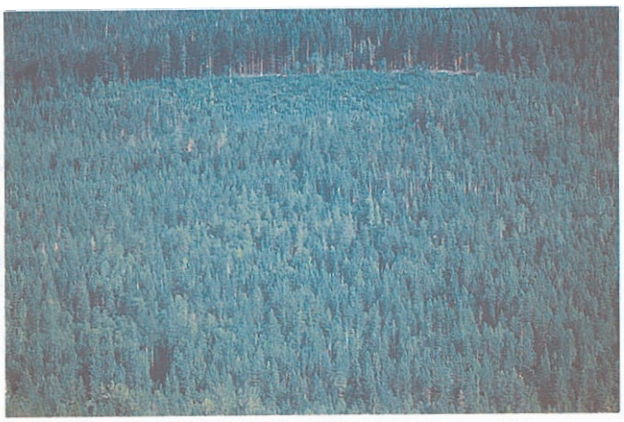
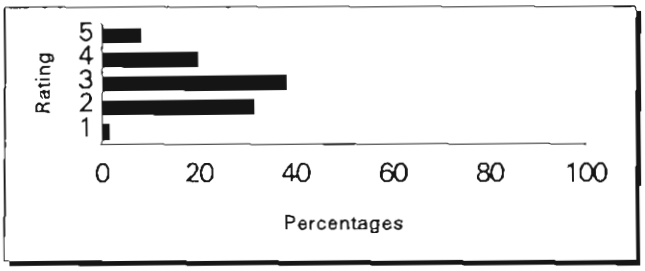


Photo 15

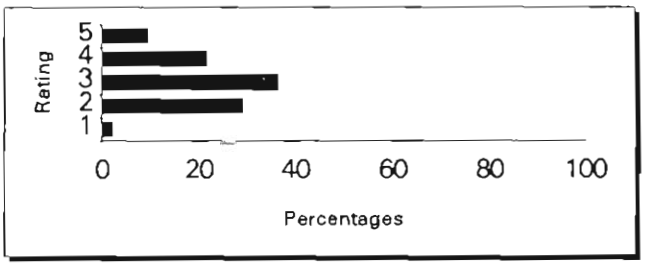


GV rating: 3.02 **Veg: YES**
Stand height: 4.5m **Age: 12 years**

Factors influencing VEG:

[–] colour contrast of standing stems on top boundary

Photo 16



GV rating: 3.07 **Veg: YES**
Stand height: 5.5m **Age: 11 years**

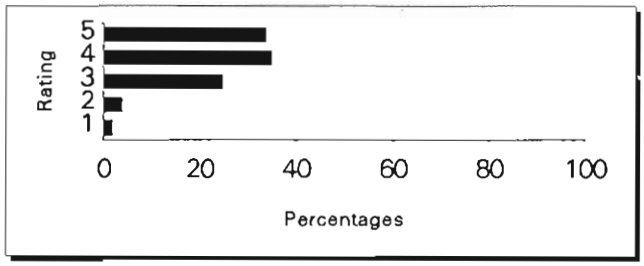
Factors influencing VEG:

[–] uniform rows - methodical/artificial

[–] some ground showing - mineral sites exposed

Range: (3.95 - 4.05)

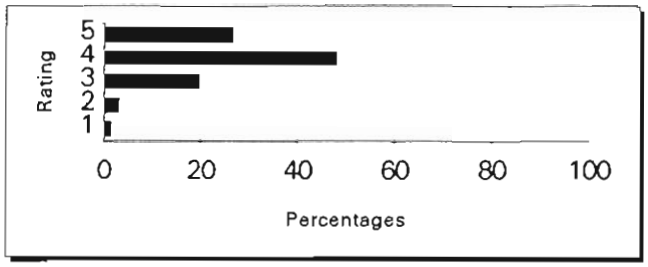
Photo 17



GV rating: 3.95 **Veg: YES**
Stand height: 6.5m **Age: 20 years**

Factors influencing VEG:
[+] natural looking openings

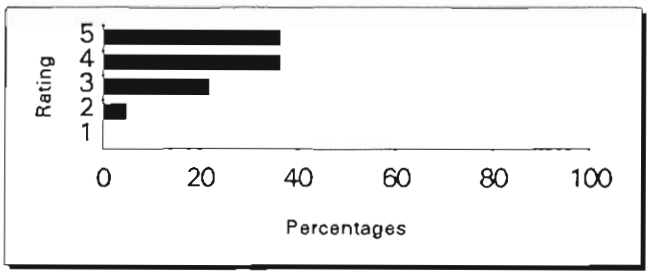
Photo 18



GV rating: 3.95 **Veg: YES**
Stand height: 10.0m **Age: 17 years**

Factors influencing VEG:
[+] varied colours
[+] regeneration beginning to break up back boundary - blends in

Photo 19

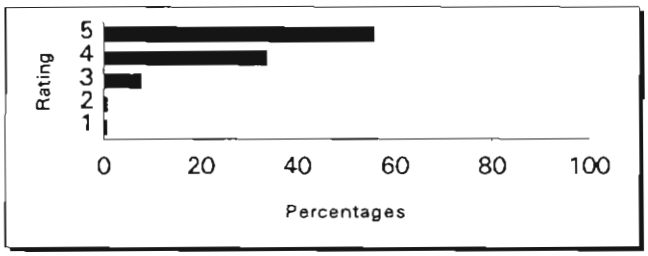


GV rating: 4.05 **Veg: YES**
Stand height: 23.0m **Age: 26 years**

Factors influencing VEG:
[–] texture contrasts with standing trees
[+] uneven boundaries

Range: (4.43 - 4.50)

Photo 20



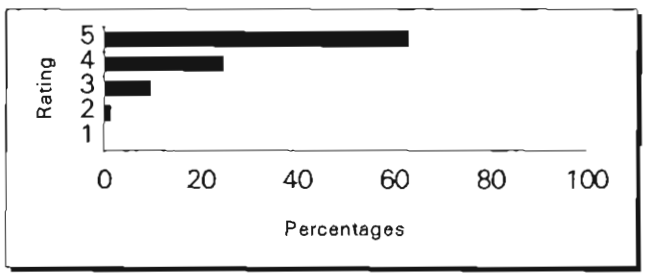
GV rating: 4.43 **Veg: YES**
Stand height: 22.5m **Age: 28 years**

Factors influencing VEG:

[–] texture contrast with standing trees

[+] view possibly improved when trees removed near waterfall

Photo 21



GV rating: 4.50 **Veg: YES**
Stand height: 12.0m **Age: 20 years**

Factors influencing VEG:

[+] varied colours

[+] blends well with surrounding forest

SAMPLE RANGE OF VEG RATINGS

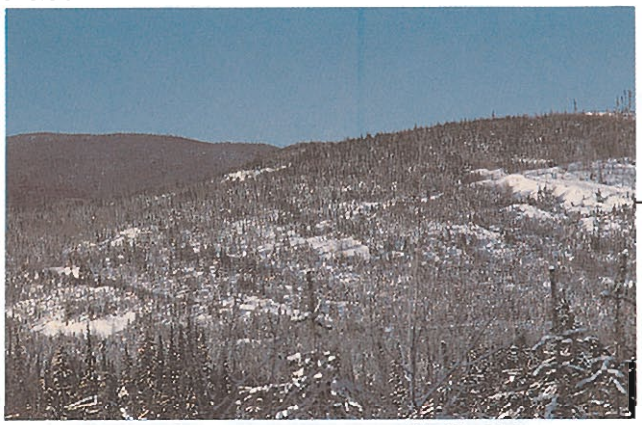
Photo 1

GV rating: 1.24 VEG: NO

Photo 2

GV rating: 1.99 VEG: NO

Photo 3

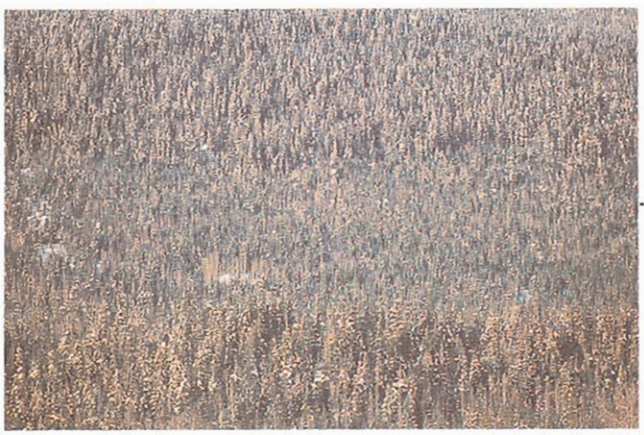


GV rating: 2.93 VEG: NO

Photo 4

GV rating: 4.17 VEG: YES

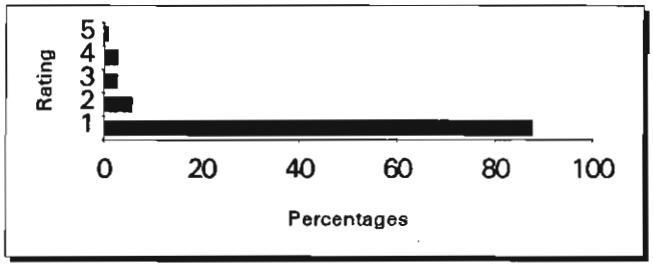
Photo 5



GV rating: 4.38 VEG: YES

VEG RATINGS - Winter

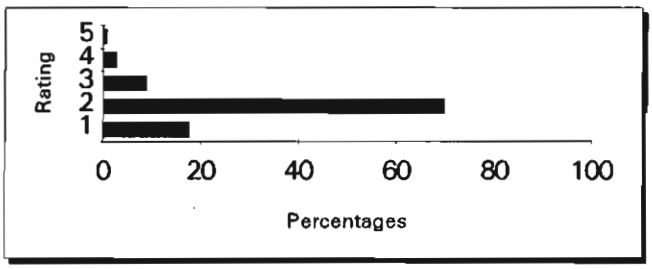
Photo 1



GV rating: 1.24 **VEG: NO**
Visible tree height: 0.5m **Age: 5 years**

Factors influencing VEG:
[–] new clearcut
[–] solid white contrasts with surrounding forest
[–] square corner

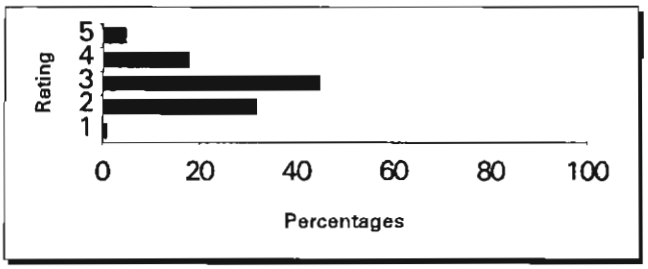
Photo 2



GV rating: 1.99 **VEG: NO**
Visible tree height: 4.5m **Age: 13 years**

Factors influencing VEG:
[–] visible ground snow - especially along top boundary
[–] patchy stocking

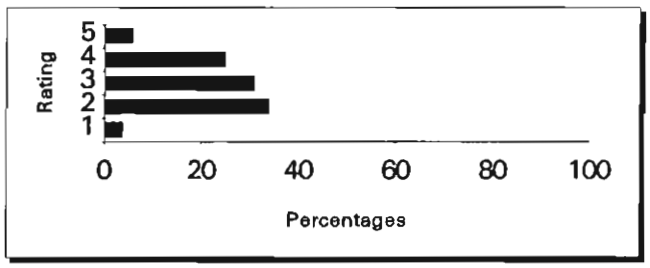
Photo 3



GV rating: 2.93 **VEG: NO**
Visible tree height: 5.5m **Age: 19 years**

Factors influencing VEG:
[–] lots of ground snow visible
[–] colour contrast with surrounding forest (even with snow in canopy)
[–] broken stocking

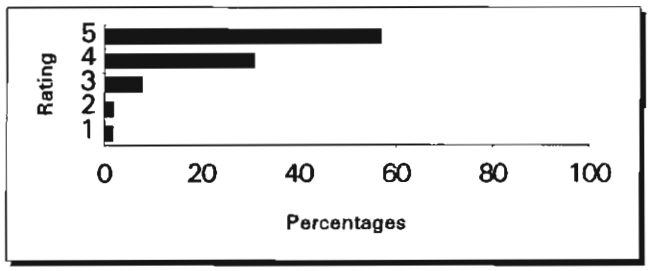
Photo 4



GV rating: 4.17 **VEG: YES**
Visible tree height: 5.5m **Age: 19 years**

Factors influencing VEG:
[+] uniform stocking
[+] uniform snow

Photo 5



GV rating: 4.38 **VEG: YES**
Visible tree height: 9.0m **Age: 24 years**

Factors influencing VEG:
[–] slight contrast in texture
[+] uniform stocking
[+] relatively uniform snow canopy

VEG RATINGS - Winter

Range: (1.26)

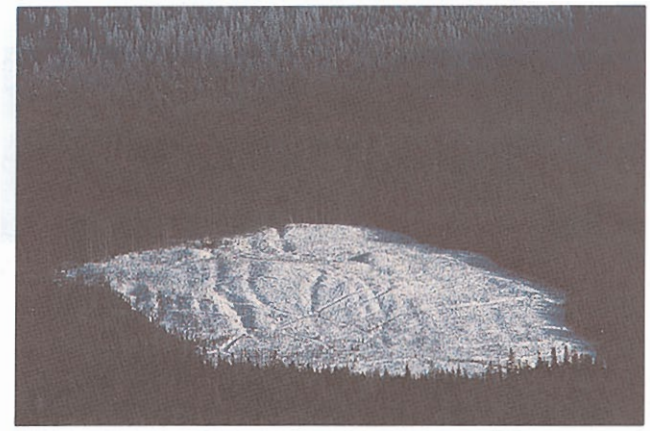
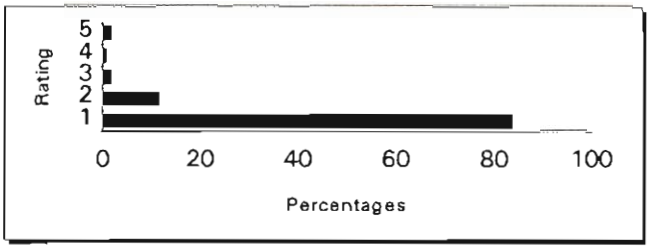


Photo 6



GV rating: 1.26 **Veg: NO**
Visible tree height: 2.0m **Age: 9 years**

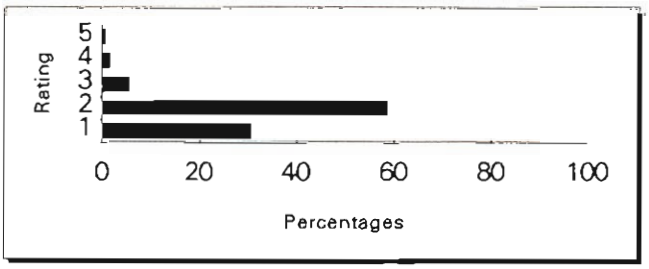
Factors influencing VEG:

[–] new clearcut - solid white contrasts strongly with standing timber

VEG RATINGS - Winter

Range: (1.82)

Photo 7



GV rating: 1.82 **Veg: NO**
Visible tree height: 3.5m **Age: 19 years**

Factors influencing VEG:

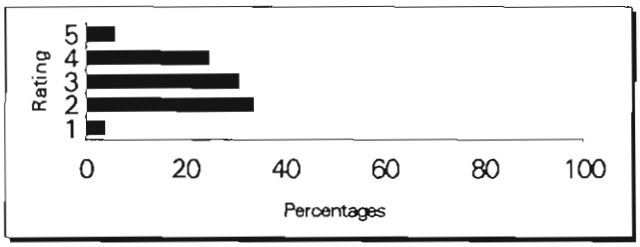
[–] a great deal of ground snow visible

[–] broken stocking - mainly deciduous

VEG RATINGS - Winter

Range: (2.94 - 3.11)

Photo 8

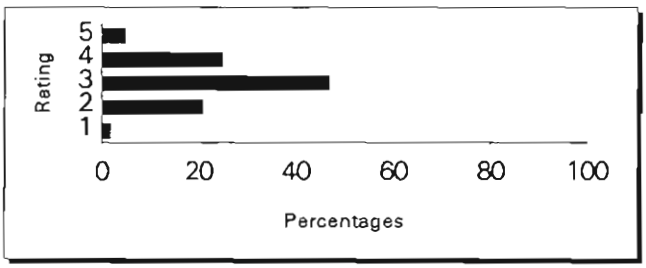


GV rating: 2.94 **Veg: NO**
Visible tree height: 4.0m **Age: 10 years**

Factors influencing VEG:

[–] deciduous content allows ground snow to show

Photo 9



GV rating: 3.11 **Veg: YES**
Visible tree height: 5.0m **Age: 15 years**

Factors influencing VEG:

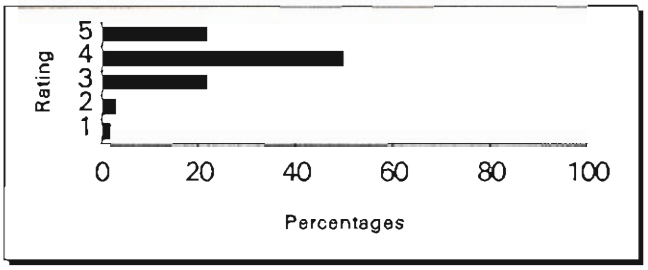
[–] ground snow visible because of deciduous stand

[–] no snow in canopy

VEG RATINGS - Winter

Range: (3.87)

Photo 10



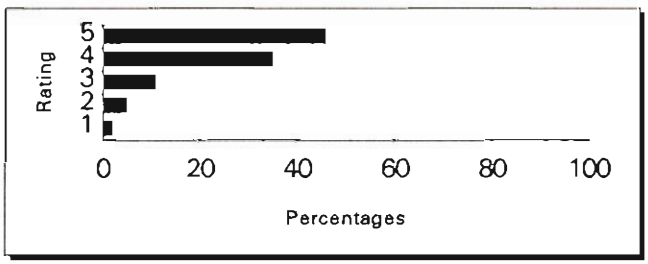
GV rating: 3.87 **Veg: YES**
Visible tree height: 10.0m **Age: 17 years**

Factors influencing VEG:
[+] some ground snow visible but canopy snow helps stand blend in

VEG RATINGS - Winter

Range: (4.19 - 4.27)

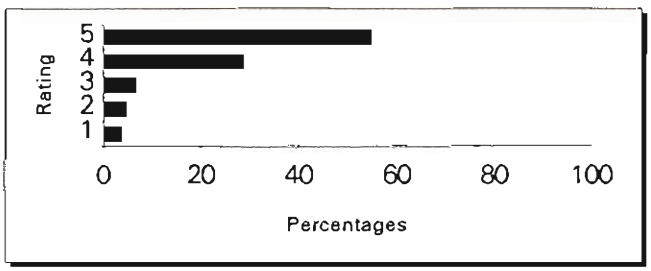
Photo 11



GV rating: 4.19 **Veg: YES**
Visible tree height: 7.0m **Age: 16 years**

Factors influencing VEG:
[+] uniform stocking

Photo 12



GV rating : 4.27 **Veg: YES**
Visible tree height: 11.5m **Age: 20 years**

Factors influencing VEG:
[–] straight white line of road
[+] uniform stocking

4.0 Conclusions

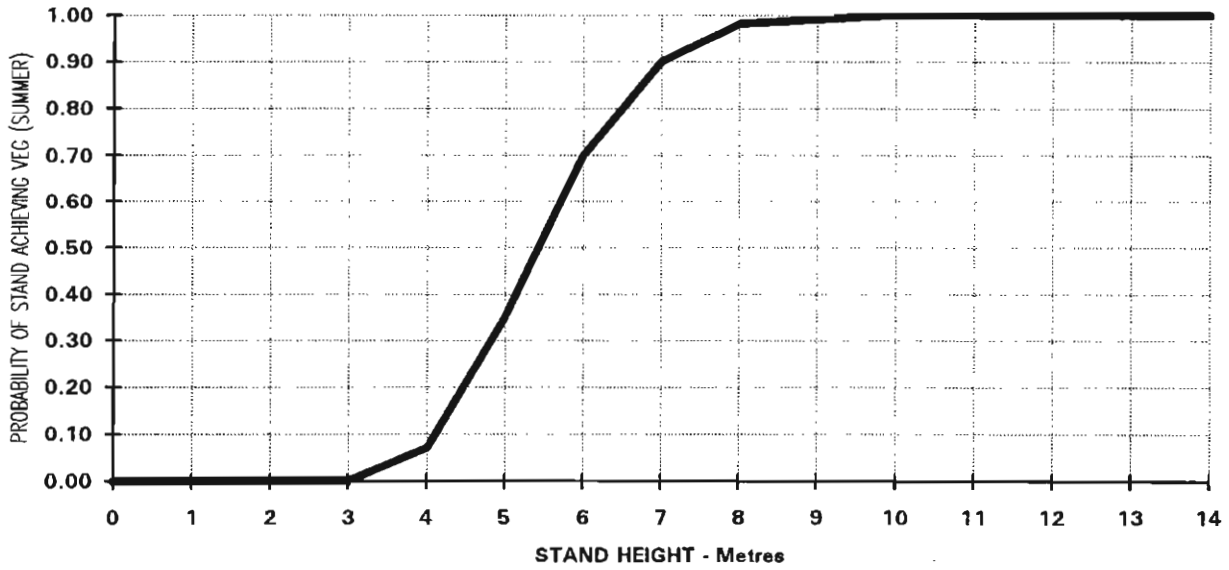
4.1 Probability of VEG in relation to stand height

Of the biophysical variables assessed in this preliminary study, stand height is the best for predicting VEG during both summer and winter conditions.

Summer VEG:

Based on an analysis of the study data (*see Appendix 6.3*), the relationship between VEG and stand height can be graphed to yield a probability curve. The resulting graphs (*see Figures 7 and 8*) show the probability of VEG for a range of stand heights.

Figure 7: Probability of summer VEG in relation to stand height



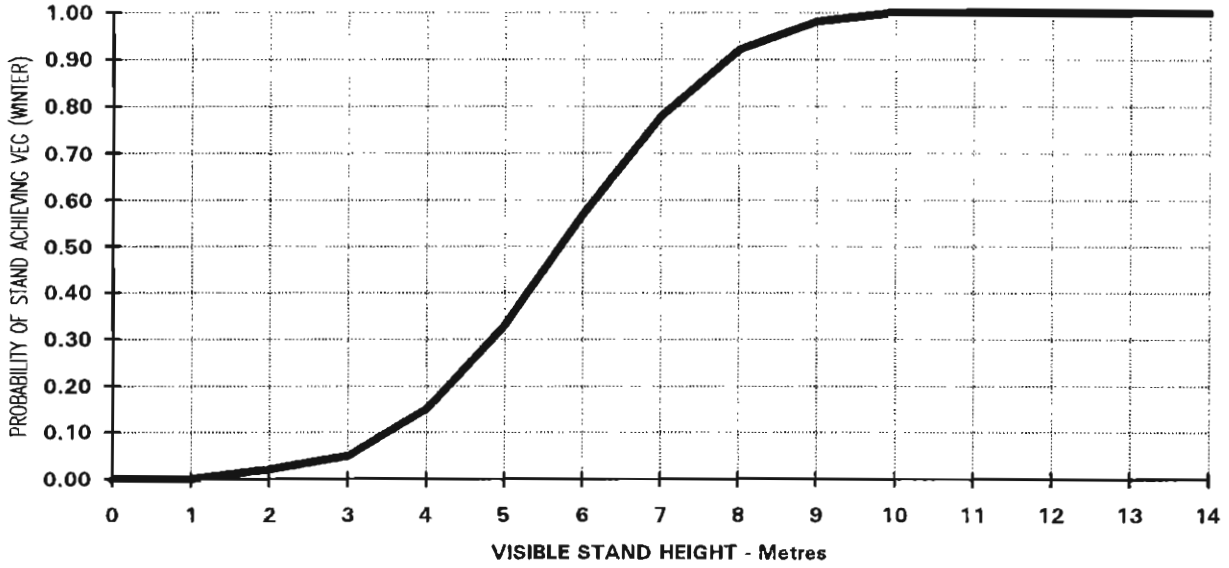
** Small sample sizes may give results that are not totally representative statistically.*

Key points for Figure 7:

- for stands 4 metres high, and under, the probability of summer VEG is less than 10%.
- for stands over 4 metres high the probability of VEG is approximately:
  - 35% for 5 metre high stands;
  - 50% for 5.5 metre high stands;
  - 70% for 6 metre high stands;
  - 90% for 7 metre high stands; and,
  - 100% for stands 10 metres high and over.
- This probability graph is based on an analysis that takes all the data points into consideration and comes up with a smooth curve to indicate the most probable VEG rating at a given stand height (*see the regression analysis for summer VEG in Appendix 6.3*). Therefore, it appears different from the raw data presented in Figure 5.

Winter VEG:

Figure 8: Probability of winter VEG in relation to visible stand height



** Small sample sizes may give results that are not totally representative statistically.*

Key points for Figure 8:

- for stands with less than 4 metres of visible tree height the probability of winter VEG is less than 20%;
- for stands with more than 4 metres of visible tree height the probability of winter VEG is approximately:
  - 35% for 5 metres;
  - 60% for 6 metres;
  - 80% for 7 metres; and,
  - 90% for 8 metres.
- This probability graph is based on an analysis that takes all the data points into consideration and comes up with a smooth line to indicate the most probable VEG rating at a given stand height (*see the regression analysis for winter VEG in Appendix 6.3*). Therefore, it appears different from the raw data presented in Figure 6.

4.2 Estimating time required to reach VEG

Please note that these results refer specifically to the sites photographed and analysed in this study.

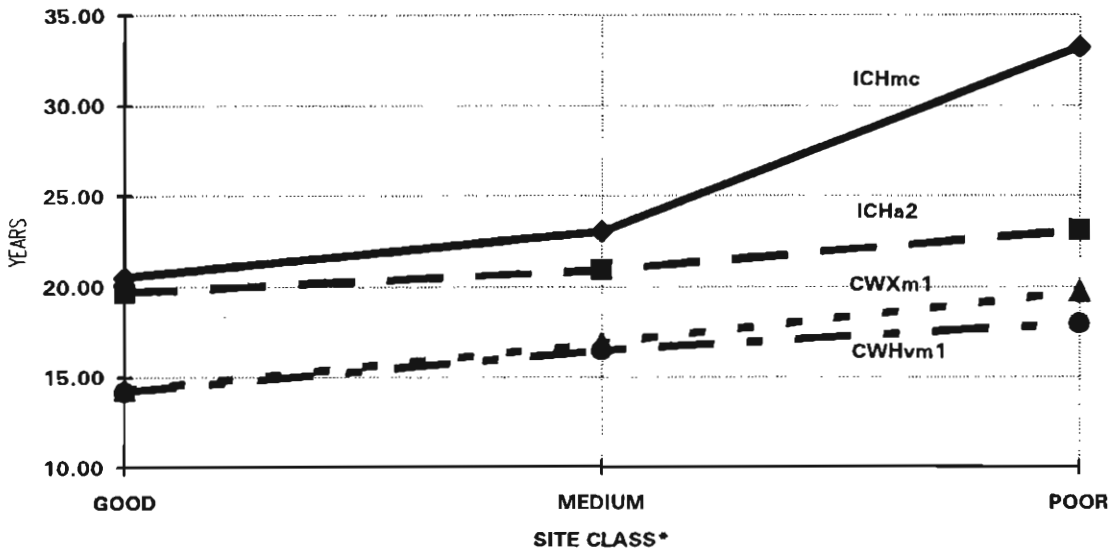
This section discusses the time required for a logged area to reach VEG. Variations can be expected in the time required to reach VEG across a wide range of site conditions, different productivity ratings, and various biogeoclimatic subzones.

Since VEG stand height varies from site to site, no single stand height is considered VEG. As we have seen, 3 or 4 metre stands may achieve VEG; however, the probability is lower than 20% (see figures 7 and 8). The probability of a 5.5 to 6 metre stand achieving VEG during summer conditions, on the other hand, is roughly 50% to 70%.

As mentioned, the time required to reach a certain tree height on a given site can often be predicted by looking at growth and yield curves for specific tree species on sites of different productivity ratings and in different biogeoclimatic zones.

To show how this information can be applied, the average number of years needed for trees to reach 5 metres has been estimated for the sites photographed in this study. The results are presented by site class and biogeoclimatic subzone in figure 9. (*Also see Appendix 6.4, Table 5 for the estimated heights at 50 years*).

Figure 9: Estimated average number of years for trees of mixed species to reach 5 metres in four biogeoclimatic subzones



* *Site classes were derived from inventory information for the sites analysed in this study. See Table 5 in the Appendices for futher information.*

Key points for Figure 9:

- trees on good sites in these subzones can be expected to reach 5 metres in roughly 14 to 20 years.
- trees on medium sites can be expected to reach 5 metres in roughly 16 to 23 years.
- trees on poor sites can take anywhere from 18 to 33 years to reach 5 metres.
- trees in the ICH mc (Hazelton Moist Cold Interior Cedar-Hemlock) subzone have the widest range, from roughly 20 years on a good site to roughly 33 years on a poor site. The difference between medium and poor sites was particularly pronounced.

These estimates were made by correlating site indices (see sidebar), generated from records, aerial photographs, and field inspections, for the species of trees and the cutblocks shown in each photograph. The resulting estimates for the number of years needed for various species to reach 5 metres was then combined for each site class, by biogeoclimatic subzone, to give the numbers reported in figure 9.

Site Quality for Timber

Sites are classified either qualitatively by soil and vegetation or quantitatively by their potential for wood production, into site class or site index.

Site class: This is a measure of the relative productive capacity of a site for the crop or stand of a given species under study, based on volume or height at a given age.

Site index: This is a measure of site quality based on the total height of the dominant trees in a stand of a given species at a reference age. In B.C. the reference age is usually 50 or 100 years. Site indices can be combined, if required, into four site classes: good, medium, poor, and low.

(Forestry Handbook for British Columbia, Fourth Edition).

4.3 Using the results

This VEG study has yielded much-needed information on current public perceptions regarding greenup in B.C.

The VEG curves (see figures 7 and 8), used in conjunction with Visual Quality Objectives (VQOs) and landscape design, will assist resource managers in predicting when an existing logged area should reach VEG and when nearby areas may be logged.

The importance of this can be appreciated if one considers that VQOs are applied at the landscape unit level. VQOs define the level of acceptable landscape alteration for a landscape unit made up of many stands. An approved VQO sets out the maximum acceptable percentage of landscape alteration for the total forested area (or total green, *see p. 4, Procedures for Factoring Recreation Resources into*

Timber Supply Analyses, MoF 1993) within a landscape unit (e.g., for Modification, the maximum acceptable alteration is 25% in plan view).

Consequently, in order to maintain a particular VQO, logged areas within a landscape unit should reach VEG before additional areas within that landscape unit are logged.

Importance of VEG probability curves

VEG probability curves provide the necessary linkage between predicting VEG and the time required for a stand to reach a certain height.

They will assist resource managers in estimating the time required for a stand to reach VEG on a given site, when used in conjunction with growth and yield curves for specific tree species on sites of different productivity ratings and in different biogeoclimatic zones.

Key uses for the results

The results from this study will be incorporated and integrated into a wide-range of planning processes and direction-setting initiatives. Even though this study represents initial research, the results are statistically valid and important to the future management of forests in B.C.

The results of this study can:

- be incorporated in visual landscape management guidelines currently being developed;
- be used in the Ministry's current Timber Supply Review; and,
- assist in visual landscape assessments and design.

4.4 Need for further studies

As discussed, this study represents a first look at VEG within the field of visual landscape management. In addition to providing preliminary data on how the public perceives the impacts of logging, this study raises a number of questions about further issues, including:

- the relative advantages and disadvantages of partial cut systems in meeting Visual Quality Objectives;
- the relationship between Perspective View and Plan View in visual landscape management;
- the affects of varying degrees of soil disturbance on achieving VQOs and VEG;
- VEG in other biogeoclimatic subzones within B.C.;
- the correlation between the scale of landscape alterations and Visual Quality Objectives in a provincial public perception study; and,
- the affects of viewing angle, or angle of incidence, on VEG.

The Forest Service recognizes the need for detailed, up-to-date information on the aesthetic and recreational values of public forest lands; particularly in view of the fundamental changes that are occurring in social priorities and expectations for how these lands should be managed. As the population of B.C. grows and unlogged areas become fewer, the demands on public forest lands will continue to increase.

More and more, the Forest Service, and other agencies and organizations, as well as individuals, are interested in how the public perceives changes to the visual landscape of public forest lands.

4.5 Statement of limitations

As mentioned, this study represents a first look at VEG within the expanding field of visual landscape management in B.C.

Although this research provides the best record we have of people's perceptions about Visually Effective Green-up, there are still limitations to the methodology used in this public perception study.

Limitations

- The study does not represent the full-range of stand types and biogeoclimatic zones in British Columbia, because of limited resources.
- The photographs do not represent all views in the field, since they were taken at mid-ground and "zoom-in" on the subject areas to minimize external biases.
- The working definition for VEG is necessarily subjective. For this study, the mid-range in mean scores is considered the cut-off line between VEG and not VEG. This is not necessarily right or wrong, but merely an attempt to make an objective, logical choice.
- The number of photos showing some stand heights is relatively small, particularly for winter VEG, and may not show enough variety. Small sample sizes may have given results that are not totally representative statistically.
- Researchers did their best in selecting a complete set of biophysical variables for the stands shown in the photographs. However, some variables influencing VEG may not have been identified and, therefore, would not have been assessed.
- The statistical analyses used may have introduced unknown biases. CHAID is one technique for determining the best predictive variable for VEG. Although it appears to be suitable for this study there may be others that would yield different, yet still statistically valid, results. The same could be said for the Linear Regression model chosen.

There are, no doubt, other limitations, but this brief overview will give some idea of the study's potential shortcomings.

Context

In spite of these limitations, however, this report presents significant and meaningful results in an objective manner. For the first time, landscape managers and the public can draw conclusions and make predictions about VEG based on an objective analysis of responses from hundreds of people.

5.0 References

Ministry of Forests and Ministry of Environment, Lands, and Parks, 1987. *Integrated Wildlife - Intensive Forestry Research (IWIFR) Program*. Research Branch, Victoria, B.C.

Ministry of Forests, 1989. *Logging in Kootenay Landscapes: The Public Response*. Land Management Report No. 57. Research Branch, Victoria, B.C.

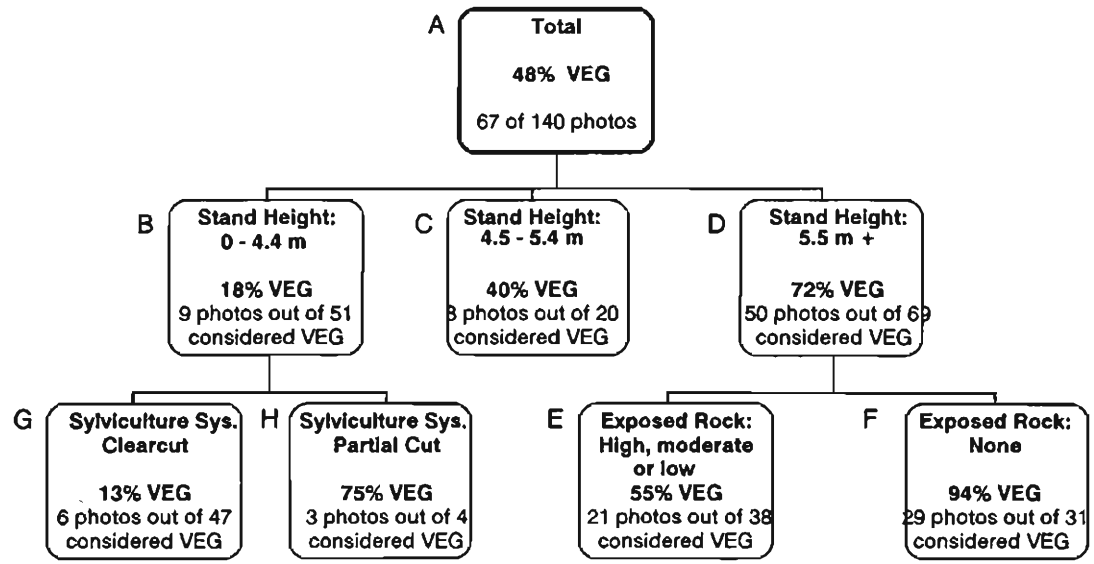
Ministry of Forests, 1992. *Okanagan Timber Supply Area Integrated Resource Management Timber Harvesting Guidelines*.

Ministry of Forests, 1993. *Procedures for Factoring Recreation Resources into Timber Supply Analyses*. Recreation Branch Technical Report 1993:1, Victoria, B.C.

6.0 Appendices

6.1 CHAID tree diagram for Summer VEG

Tree diagram for the combined data set (all biogeoclimatic subzones) using a 3.0 Mean Green-up Value cut-off score for VEG. All variables are included in the analysis.

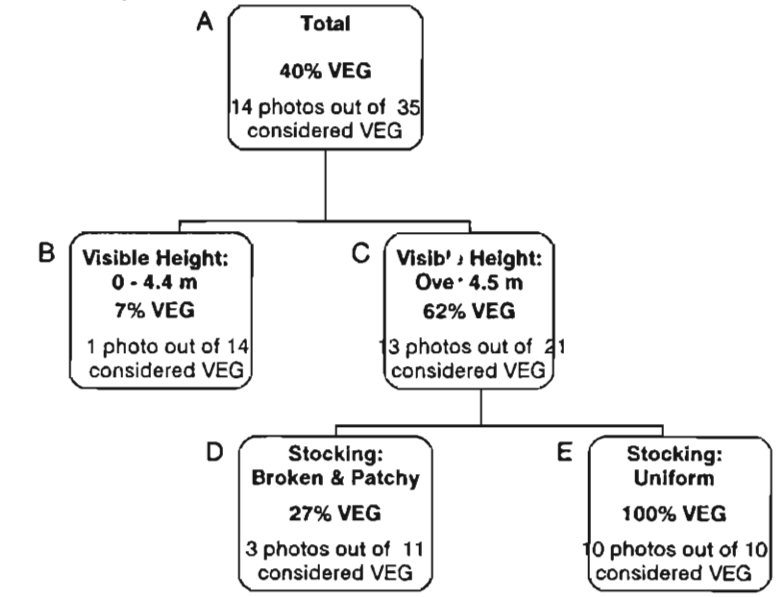


Detailed analysis:

- the response for stand height was statistically different for three sets of categories:
  - box B shows that for stand heights 0 to 4.4 metres 18% were VEG.
  - box C shows that for stand heights 4.5 to 5.4 metres 40% were VEG.
  - box D shows that for stand heights over 5.5 metres 72% were VEG.
- for stand heights over 5.5 metres the second best predictive variable was exposed rock and soil:
  - box E shows that of the 38 slides showing low, moderate or high amounts of exposed rock and soil, 55% were VEG.
  - box G shows that of the 31 slides showing no exposed rock and soil 94% were VEG.
- for stand height of 4.5 to 5.4 metres there was no second best predictive variable.
- for stand heights of 0-4.4 metres the second best predictive variable was silviculture system, or harvesting method (i.e., clearcut, shelterwood, seedtree, etc):
  - box G shows that for clearcuts with regenerated stand heights of 0 to 4.4 metres, 13% were VEG.
  - box H shows that for photos showing partial cut harvesting systems, 75% were VEG.

6.2 CHAID tree diagram for Winter VEG:

Tree diagram using a 3.0 Mean Green-up Value cut-off score for VEG. All variables are included in the analysis.



Detailed analysis:

- the response for visible stand height was statistically different for two sets of categories:
  - box B shows that for visible stand heights of 0 to 4.4 metres, 7% were considered VEG.
  - box C shows that for visible stand heights over 4.5 metres, 62% were considered VEG.
- continuing down from box B we see that the next variable to split off was stocking, or the arrangement of trees in the disturbed areas.
- for visible stand heights over 4.5 metres:
  - box D shows that 27% of the stands with broken and patchy stocking were VEG
  - box E shows that 100% of the stands with uniform stocking were VEG
- therefore, we can say that the probability of winter VEG is further increased when uniform stocking is combined with tree heights greater than 4.5 metres.

6.3 Regression analyses

Linear regression analyses have been used to model the relationship between the Mean GV Score (dependent variable GV) and the associated Visible Stand Height (independent variable H) for both summer and winter data.

Summer VEG

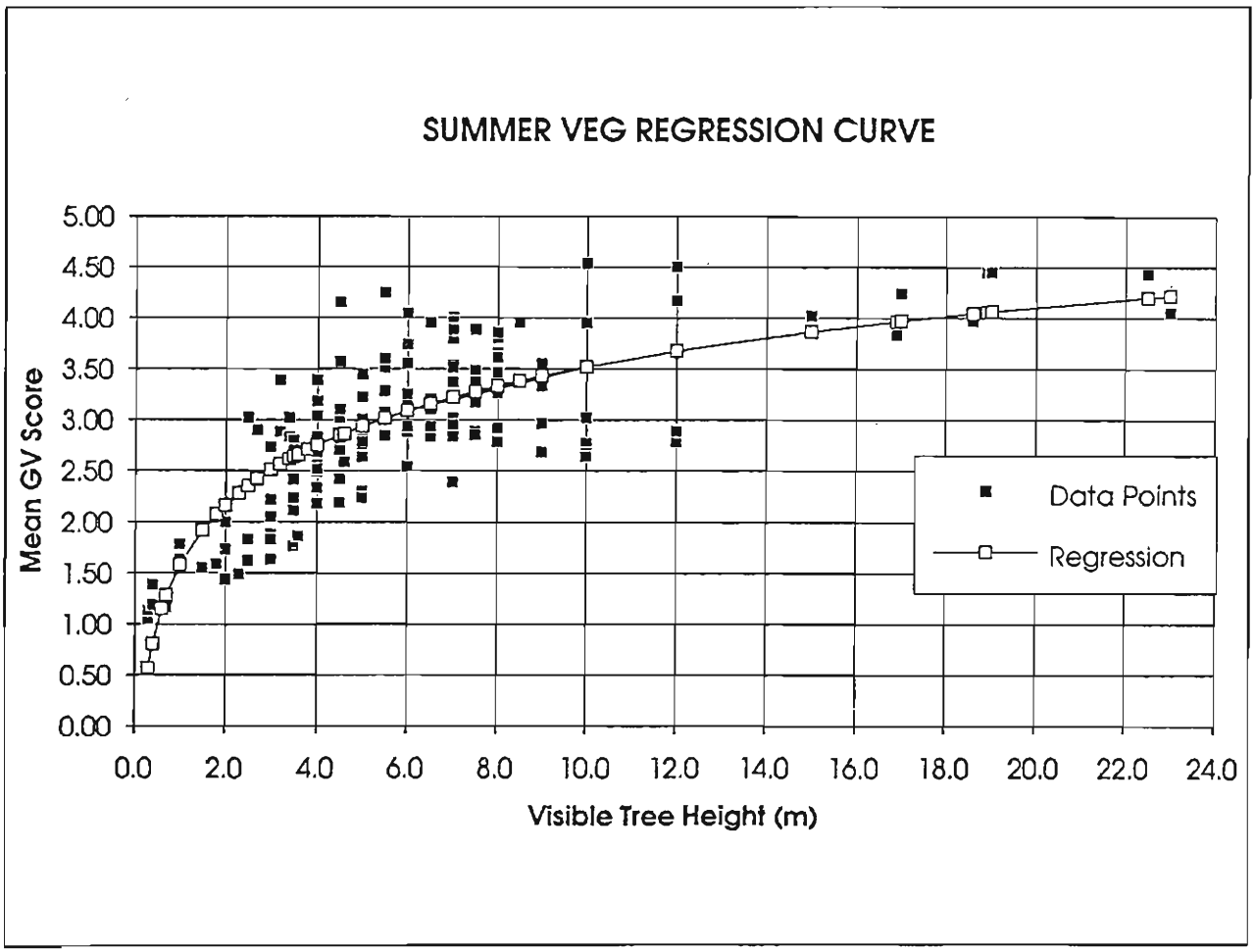
This analysis was carried out on the data for 136 summer VEG photographs showing clearcut sites. Four photographs showing selectively logged areas were excluded.

The equation for the best-fit regression line was found to be:

$$GV = 2.24*\log(H) + 1.60$$

with an R^2 value of 0.71 and a standard error (SE) for the GV estimates of 0.17.

The figure below graphically shows the results of this analysis:



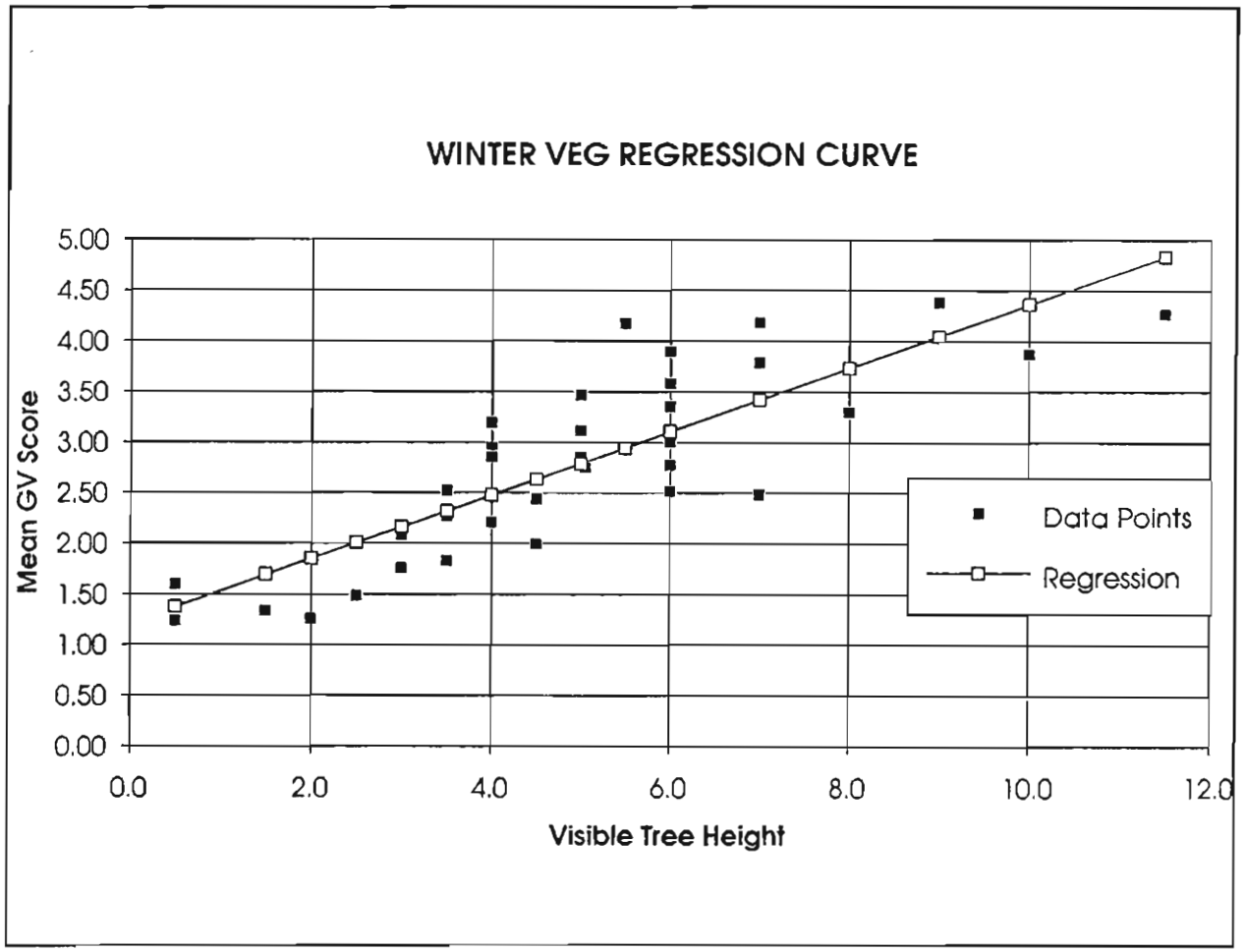
Winter VEG

This analysis was carried out on the data for all 35 winter VEG photographs. The equation for the best-fit regression line was found to be:

$$GV = 0.31H + 1.223$$

with an R^2 value of 0.70 and a standard error (SE) for the GV estimate of 0.50.

The figure below graphically shows the results of this analysis:



For any fixed value of stand height, the distribution of the dependent variable GV is assumed in a regression analysis to be normal with mean $\mu_{GV/H}$ (the mean of GV for a given H) and a constant standard deviation of σ is the standard error of the GV estimate (SE). For a given stand height, a certain portion of the bell curve of the normal distribution crosses the critical GV score of 3.0, above which the cutblock is considered VEG. The area under the portion of the curve above GV=3.0 represents the probability of VEG given a particular stand height.

These probability values are graphed in figures 7 and 8.

6.4 Tables of results

The following tables are found in this section:

Table 1: Height and age comparisons for summer VEG

Photo #	BGCS	Avg GV	VEG Y or N	Tree Height	Age
17	ICHa/mw	4.53	Y	10.0	24
24	ICHa/mw	4.50	Y	12.0	20
32	CWHxm1	4.45	Y	19.0	26
29	CWHvm1	4.44	Y	18.9	28
29	CWHxm1	4.43	Y	22.5	28
8	CWHxm1	4.25	Y	5.5	12
7	CWHvm1	4.24	Y	17.0	23
1	CWHxm1	4.17	Y	12.0	28
34	CWHvm1	4.15	Y	4.5	12
14	CWHvm1	4.05	Y	23.0	26
33	ICHmc3	4.04	Y	6.0	24
1	CWHvm1	4.02	Y	15.0	24
13	ICHa/mw	4.00	Y	7.0	16
33	CWHxm1	3.97	Y	18.6	24
24	ICHmc3	3.96	Y	7.0	16
11	ICHa/mw	3.95	Y	10.0	17
17	CWHxm1	3.95	Y	6.5	20
6	CWHvm1	3.95	Y	8.5	15
27	CWHxm1	3.88	Y	7.0	18
27	CWHvm1	3.88	Y	7.5	10
3	CWHxm1	3.85	Y	8.0	20
24	CWHxm1	3.83	Y	16.9	29
8	ICHmc3	3.80	Y	8.0	26
12	CWHxm1	3.79	Y	7.0	12
8	ICHa/mw	3.78	Y	0.4	4
17	ICHmc3	3.78	Y	7.0	18
6	ICHmc3	3.74	Y	6.0	18
21	ICHmc3	3.67	Y	1.3	13
21	ICHa/mw	3.65	Y	8.0	26
8	CWHvm1	3.61	Y	8.0	12
14	ICHmc3	3.60	Y	5.5	18
30	ICHmc3	3.57	Y	4.5	12
32	ICHa/mw	3.55	Y	9.0	15
28	CWHxm1	3.55	Y	6.0	10
3	ICHa/mw	3.53	Y	7.0	18
25	ICHmc3	3.51	Y	5.5	19
10	CWHvm1	3.51	Y	7.0	12
19	ICHa/mw	3.48	Y	7.5	19
17	CWHvm1	3.46	Y	8.0	12
25	CWHvm1	3.44	Y	5.0	13
22	CWHxm1	3.42	Y	8.0	18
29	ICHmc3	3.39	Y	4.0	19
16	ICHmc3	3.39	Y	3.2	12
13	CWHvm1	3.37	Y	7.5	10
35	CWHvm1	3.37	Y	7.0	15
19	ICHmc3	3.33	Y	9.0	18
10	ICHmc3	3.28	Y	5.5	12

Table 1: Height and Age Comparisons for Summer VEG

Photo #	BGCS	Avg GV	VEG Y or N	Tree Height	Age
9	CWHxm1	3.26	Y	8.0	18
34	CWHxm1	3.25	Y	6.0	15
4	CWHvm1	3.22	Y	5.0	12
16	ICHa/mw	3.20	Y	6.5	20
2	ICHa/mw	3.20	Y	0.0	0
7	ICHmc3	3.18	Y	4.0	12
13	ICHmc3	3.17	Y	7.5	17
7	ICHa/mw	3.15	Y	6.0	18
4	ICHmc3	3.10	Y	4.5	15
2	CWHvm1	3.10	Y	6.5	12
19	CWHvm1	3.07	Y	5.5	11
16	CWHxm1	3.04	Y	4.0	12
29	ICHa/mw	3.02	Y	4.5	12
15	ICHmc3	3.02	Y	5.5	17
12	ICHmc3	3.02	Y	3.4	10
20	CWHxm1	3.02	Y	10.0	19
21	CWHxm1	3.02	Y	2.5	11
33	CWHvm1	3.02	Y	5.5	13
18	CWHxm1	3.01	Y	7.0	10
22	ICHmc3	3.00	Y	5.0	13
12	ICHa/mw	2.97	N	1.3	13
15	CWHxm1	2.96	N	9.0	14
32	CWHvm1	2.95	N	7.0	15
28	CWHvm1	2.93	N	6.5	11
11	CWHxm1	2.92	N	8.0	16
6	ICHa/mw	2.90	N	2.7	16
2	ICHmc3	2.89	N	12.0	25
35	ICHa/mw	2.88	N	7.5	17
15	ICHa/mw	2.88	N	6.0	12
27	ICHa/mw	2.88	N	3.2	12
22	CWHvm1	2.85	N	7.5	12
13	CWHxm1	2.84	N	5.5	11
25	ICHa/mw	2.83	N	7.0	20
14	ICHa/mw	2.83	N	3.4	10
26	ICHmc3	2.83	N	4.0	10
7	CWHxm1	2.83	N	6.5	12
22	ICHa/mw	2.82	N	4.5	15
33	ICHa/mw	2.80	N	3.5	11
20	CWHvm1	2.80	N	5.0	11
10	ICHa/mw	2.78	N	12.0	25
30	CWHxm1	2.78	N	8.0	12
23	CWHvm1	2.78	N	5.0	8
1	ICHmc3	2.77	N	4.0	19
5	CWHxm1	2.77	N	10.0	17
16	CWHvm1	2.76	N	5.0	12
35	ICHmc3	2.73	N	3.0	16
23	CWHxm1	2.71	N	3.8	8

Table 1: Height and Age Comparisons for Summer VEG

Photo #	BGCS	Avg GV	VEG Y or N	Tree Height	Age
4	ICHa/mw	2.70	N	4.5	12
27	ICHmc3	2.70	N	3.5	11
1	ICHa/mw	2.68	N	4.0	14
19	CWHxm1	2.68	N	9.0	14
23	ICHa/mw	2.67	N	5.0	13
6	CWHxm1	2.67	N	10.0	20
35	CWHxm1	2.64	N	10 0	20
32	ICHmc3	2.63	N	5.0	15
18	ICHmc3	2.58	N	4.6	21
5	ICHa/mw	2.55	N	4.0	10
18	CWHvm1	2.54	N	6.0	11
31	CWHxm1	2.51	N	4.0	10
25	CWHxm1	2.49	N	4.0	12
9	ICHa/mw	2.42	N	4.5	12
9	CWHvm1	2.41	N	3.5	10
24	CWHvm1	2.39	N	7.0	11
2	CWHxm1	2.33	N	4.0	12
18	ICHa/mw	2.30	N	5.0	15
9	ICHmc3	2.24	N	3.5	13
5	ICHmc3	2.23	N	5.0	16
31	ICHa/mw	2.22	N	3.0	8
10	CWHxm1	2.19	N	4.5	11
14	CWHxm1	2.18	N	4.0	12
11	ICHmc3	2.11	N	3.5	18
20	ICHa/mw	2.05	N	3.0	10
30	CWHvm1	2.00	N	2.0	6
3	CWHvm1	1.88	N	3.0	8
23	ICHmc3	1.86	N	3.6	10
34	ICHmc3	1.83	N	2.5	9
12	CWHvm1	1.83	N	3.0	7
28	ICHmc3	1.78	N	1.0	5
21	CWHvm1	1.76	N	3.5	7
11	CWHvm1	1.73	N	2.0	5
26	ICHa/mw	1.63	N	1.0	5
26	CWHvm1	1.63	N	3.0	7
30	ICHa/mw	1.62	N	2.5	9
15	CWHvm1	1.59	N	1.8	5
31	ICHmc3	1.55	N	1.5	5
5	CWHvm1	1.49	N	2.3	6
26	CWHxm1	1.44	N	2.0	8
4	CWHxm1	1.39	N	0.4	2
3	ICHmc3	1.19	N	0.4	2
31	CWHvm1	1.17	N	0.7	4
28	ICHa/mw	1.15	N	0.6	5
20	ICHmc3	1.13	N	0.3	2
34	ICHa/mw	1.05	N	0.3	3

Table 2: Height and age comparisons for winter VEG

Table 2: Height and Age Comparisons for Winter VEG

Winter Photo #	Summe Photo #	BGCS	Winter Avg GV	Winter VEG	Summe Avg GV	Summer VEG	Visible Tree Ht	Stocking	Age
26	17	ICHa/mw2	4.38	Y	4.53	Y	9.0	u	24
11	24	ICHa/mw2	4.27	Y	4.50	Y	11.5	u	20
3	13	ICHa/mw2	4.19	Y	4.00	Y	7.0	u	16
22vp1	10	ICHmc3	4.17	Y	3.28	Y	6.0	b	19
24	16	ICHa/mw2	3.89	Y	3.20	Y	6.0	u	20
29	11	ICHa/mw2	3.87	Y	3.95	Y	10.0	u	17
2	19	ICHa/mw2	3.78	Y	3.48	Y	7.0	u	19
33vp1	33	ICHmc3	3.58	Y	4.04	Y	6.0	u	24
15vp2	14	ICHmc3	3.46	Y	3.60	Y	5.0	u	18
16	3	ICHa/mw2	3.35	Y	3.53	Y	6.0	u	18
27	21	ICHa/mw2	3.29	Y	3.65	Y	8.0	b	26
27vp1	29	ICHmc3	3.19	Y	3.39	Y	4.0	u	19
23	22	ICHa/mw2	3.11	Y	2.82	Y	5.0	b	15
21	7	ICHa/mw2	3.01	Y	3.15	Y	6.0	u	18
18	5	ICHa/mw2	2.94	N	2.55	N	4.0	u	10
22vp2	25	ICHmc3	2.93	N	3.51	Y	5.5	b	19
24vp1	7	ICHmc3	2.85	N	3.18	Y	5.0	b	12
27vp2	1	ICHmc3	2.85	N	2.77	N	4.0	b	19
17vp1	15	ICHmc3	2.78	N	3.02	Y	6.0	b	17
41	14	ICHa/mw2	2.52	N	2.83	N	3.5	b	10
13	15	ICHa/mw2	2.51	N	2.88	N	6.0	b	12
28	35	ICHa/mw2	2.48	N	2.88	N	7.0	b	17
19	4	ICHa/mw2	2.44	N	2.44	N	4.5	b	12
7	32	ICHa/mw2	2.27	N	3.55	Y	3.5	p	15
17	29	ICHa/mw2	2.21	N	3.02	Y	4.0	b	12
12vp1	11	ICHmc3	2.08	N	2.11	N	3.0	p	18
31	23	ICHa/mw2	1.99	N	2.67	N	4.5	b	13
4	16	ICHmc3	1.82	N	3.48	Y	3.5	p	19
12	20	ICHa/mw2	1.75	N	2.05	N	3.0	p	10
5vp1	31	ICHmc3	1.60	N	1.55	N	0.5	p	8
1	31	ICHa/mw2	1.49	N	2.22	N	2.5	u	8
6	10	ICHa/mw2	1.43	N	2.78	N	11.0	p	25
20	26	ICHa/mw2	1.33	N	1.63	N	1.5	p	5
14	30	ICHa/mw2	1.26	N	1.62	N	2.0	u	9
35	28	ICHa/mw2	1.24	N	1.15	N	0.5	b	5

Table 3: Biophysical variables for summer VEG

A detailed look at Table 3 shows:

- the degree of slope shown in the photographs was as follows:
  - 41% of photos gentle (0-30% slope)
  - 28% of photos moderate (31-40% slope)
  - 31% of photos steep (41% slope and over)
- the harvesting method shown on 97% of the sites was clearcut logging.
- the stand age shown on 72% of sites was between 9 and 20 years. 16% were under 9 years old and 11% were over 20 years old.
- the stand height shown on 71% of sites was between 2.5 and 8.4 metres. 13% were under 2.4 metres and 16% were over 8.5 metres.
- the viewing angle shown in 92% of the photographs was between -20 degrees to +20 degrees. 44% were in the level to +10 degree range.

TABLE 3: BIOPHYSICAL VARIABLES FOR SUMMER VEG

VARIABLE	CATEGORY	FREQUENCY
Slope	1 : 0-10 %	6
	2 : 10-20 %	25
	3 : 20-30 %	26
	4 : 30-40 %	39
	5 : 40+ %	44
Aspect	1 : East	22
	2 : North	41
	3 : South	52
	4 : West	23
	5 : Southwest	2
Site Class	1 : Excellent	4
	2 : Good	16
	3 : Medium	108
	4 : Poor	12
Stocking Status	1 : NSR	3
	2 : SR	137
Free Growing	1 : No	33
	2 : Yes	106
	3 : Else	1
Terrain	1 : Broken	2
	2 : Even	92
	3 : Gullied	4
	4 : Rolling	42

VARIABLE	CATEGORY	FREQUENCY
Slope Position	1 : Crest	1
	2 : Upper Slope	25
	3 : Mid Slope	52
	4 : Lower Slope	39
	5 : Toe of Slope	22
	6 : Level	1
Stand Age	1 : 1-2 years old	4
	2 : 3-4 years old	3
	3 : 5-6 years old	8
	4 : 7-8 years old	8
	5 : 9-10 years old	13
	6 : 11-12 years old	34
	7 : 13-14 years old	12
	8 : 15-16 years old	15
	9 : 17-18 years old	15
	10 : 19-20 years old	12
	11 : 21-22 years old	1
	12 : 23-34 years old	5
	13 : 25-26 years old	6
	14 : 27-28 years old	3
	15 : 29+ years old	1
Stand Height	1 : 0-1.4 m	12
	2 : 1.5-2.4 m	6
	3 : 2.5-3.4 m	14
	4 : 3.5-4.4 m	19
	5 : 4.5-5.4 m	20
	6 : 5.5-6.4 m	15
	7 : 6.5-7.4 m	17
	8 : 7.5-8.4 m	15
	9 : 8.5-9.4 m	5
	10 : 9.5-10.4 m	5
	12 : 11.5-12.4 m	4
	14 : 14.5+ m	8

VARIABLE	CATEGORY	FREQUENCY
Stand Density	1 : 0-500 s/ha	1
	2 : 500-1000 s/ha	11
	3 : 1000-1500 s/ha	31
	4 : 1500-2000 s/ha	28
	5 : 2000-3000 s/ha	25
	6 : 3000-4000 s/ha	17
	7 : 4000-5000 s/ha	6
	8 : 5000-6000 s/ha	12
	9 : 6000-7000 s/ha	1
	10 : 7000-8000 s/ha	1
	11 : 8000+ s/ha	7
Percent Disturbance	1 : 0-10 %	21
	2 : 10-20 %	27
	3 : 20-30 %	30
	4 : 30-40 %	20
	5 : 40-50 %	10
	6 : 50-60 %	9
	7 : 60-70 %	9
	8 : 70-80 %	5
	9 : 80-90 %	3
	10 : 90-100 %	6
Visible Site Disturbances	1 : Highly Visible	22
	2 : Not Visible	63
	3 : Somewhat Visible	55

Visually Effective Green-up

VARIABLE	CATEGORY	FREQUENCY
Natural Openings	1 : Diverse	7
	2 : Some	43
	3 : Uniform	89
	4 : Else	1
Natural Patterns	1 : Diverse	20
	2 : Some	91
	3 : Uniform	29
Visual Absorption Capability	1 : High	9
	2 : Low	78
	3 : Medium	53
Existing Visual Condition	1 : Modified	73
	2 : Somewhat Modified	53
	3 : Natural	4
	4: Else	10
Silvicultural System	1 : Clearcut	136
	2 : Shelterwood	1
	3 : Seedtree	1
	4 : Else	2
Harvesting Method	1 : Cat	38
	2 : Skidder	37
	3 : Cable	64
	4 : Else	1
Site Preparation Method	1 : Broadcast Burn	60
	2 : Spot Burned	18
	3 : Machine Site Prep.	6
	4 : Windrow	2
	5 : Else	54
Regeneration Method	1 : Artificial	85
	2 : Natural	55
Stand Treatments	1 : Yes	32
	2 : No	105
	3 : Else	3
Brush Cover	1 : High	2
	2 : Moderate	55
	3 : Low	72
	4 : Nil	11

VARIABLE	CATEGORY	FREQUENCY
Exposed Rock and Soil	1 : High	5
	2 : Moderate	29
	3 : Low	44
	4 : Nil	61
	5 : Else	1

Table 4: Biophysical variables for winter VEG

A detailed look at Table 4 shows:

- the visible stand height, or tree heights visible above the snow pack, ranged from 1 metre to over 11.5 metres in the photographs, as follows:
  - 71% had 2.5 - 7.4 metres of visible height;
  - 11% had under 2.4 metres visible height; and,
  - 17% had over 7.5 metres visible height.
- roads were visible in 42% of the photographs. The amount of visible road was moderate in 31% of photos, high in 3%, and low in 9%.
- snow appeared in the tree canopies in 71% of the photographs.
- the snow depth was between 60 cm and 80 cm in 74% of the photographs.
- the stocking, or arrangement of visible stands, shown in the photographs was:
  - 40% broken;
  - 40% uniform; and,
  - 20% patchy.
- the degree of slope shown in the photographs was as follows:
  - 52% gentle (0-30% slope)
  - 31% moderate (31-40% slope)
  - 17% steep (41% slope and over)

TABLE 4: BIOPHYSICAL VARIABLES FOR WINTER VEG

VARIABLE	CATEGORY	FREQUENCY
Visible Stand Height	1 : 0-1.4 m	2
	2 : 1.5-2.4 m	2
	3 : 2.5-3.4 m	3
	4 : 3.5-4.4 m	7
	5 : 4.5-5.4 m	5
	6 : 5.5-6.4 m	8
	7 : 6.5-7.4 m	3
	8 : 7.5-8.4 m	1
	9 : 8.5-9.4 m	1
	10 : 9.5-10.4 m	1
	11 : 10.5-11.4 m	1
	12 : 11.5 + m	1
Snow Depth	1 : 0.5-0.6m	2
	2 : 0.6-0.7m	15
	3 : 0.7-0.8m	11
	4 : 0.8-0.9m	3
	5 : 0.9-1.0m	3
	6 : 1.2-1.3m	1

VARIABLE	CATEGORY	FREQUENCY
Canopy Snow	1 : No	10
	2 : Yes	25
Visible Snow	1 : High	6
	2 : Moderate	9
	3 : Low	12
	4 : Nil	8
Visible Roads	1 : High	1
	2 : Moderate	11
	3 : Low	3
	4 : Nil	20
Slope	1 : 0-10 %	1
	2 : 10-20 %	7
	3 : 20-30 %	10
	4 : 30-40 %	11
	5 : 40+ %	6
Stocking	1 : Broken	14
	2 : Uniform	14
	3 : Patchy	7

Table 5: Reference heights for site classes on VEG study sites

The following table was generated specifically for this report by the MoF Inventory and Research Branches, and shows the estimated heights that various tree species should reach in 50 years on the sites photographed, by site class.

Reference heights in metres for site classes of the tree species on VEG study sites at the reference age of 50 years.

TREE SPECIES	SITE CLASS		
	GOOD	MEDIUM	LOW
Coast:			
Douglas fir	>29.15	29.15-22.65	<22.65
Western hemlock	>24.65	24.65-18.15	<18.15
Interior:			
lodgepole pine	>17.10	17.10-13.35	<13.35
Douglas fir	>28.80	28.00-18.80	<18.80
Western hemlock	>19.25	19.25-15.05	<15.05
Western red cedar	>20.30	20.30-16.10	<16.10
spruce species	>15.90	15.90-12.25	<12.25